DOCUMENT RESUME

ED 129 464 PS 008 888

| | |
|---|---|
| AUTHOR | Alward, Keith R.; And Others |
| TITLE | Exploring Children's Thinking. Part 1: The Development of Classification (Preschool - Third Grade). |
| INSTITUTION | Far West Lab. for Educational Research and Development, San Francisco, Calif. |
| SPONS AGENCY | National Inst. of Education (DHEW), Washington, D.C. |
| PUB DATE | 75 |
| NOTE | 177p.; For related documents, see PS 008 875-891 |
| AVAILABLE FROM | Far West Laboratory for Educational Research and Development, 1855 Folsom Street, San Francisco, California 94103 ($6.95) |
| EDRS PRICE | MF-$0.83 HC-$10.03 Plus Postage. |
| DESCRIPTORS | Annotated Bibliographies; *Classification; *Cognitive Development; Concept Teaching; Developmental Stages; *Early Childhood Education; Elementary Education; Interviews; Neurological Organization; Performance Based Education; *Performance Based Teacher Education; Preschool Education; Role Playing; Teacher Education; *Teacher Education Curriculum; Thought Processes; Video Tape Recordings |
| IDENTIFIERS | Far West Laboratory for Educational R and D; *Flexible Learning System; *Piaget (Jean) |

ABSTRACT

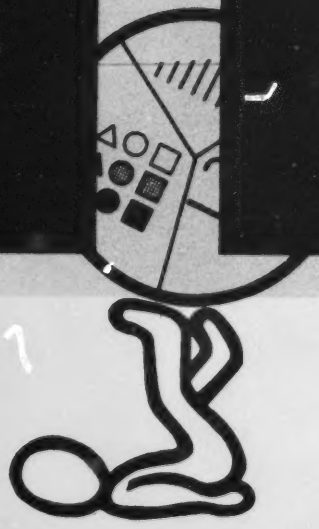
This unit of the Flexible Learning System (FLS), the first of a 3-volume series on children's thinking, discusses the development of classification in children between 3 and 8 years of age. The series is based on the application of Jean Piaget's work to early childhood education. The development of classification is revealed in the way children use judgments about similarities and differences and the concepts of "some" and "all." The unit is designed to be used with a group of adults to help them understand class and its organization in the preconceptual, intuitive and concrete-operational stages of development. Practice in exploring children's thinking is provided. Activities include thought problems, role playing, child interviews, discussions, readings, and viewing a color videotape on classification from a series entitled The Growing Mind: A Piagetian View of Young Children. Rip-out guided interview forms are provided for all interviews. Also included are an introduction to Piaget and his general theory, educational implications of the theory, classification materials, a transcript of the videotape, and an annotated bibliography. Related FLS units exploring children's thinking: "Exploring Children's Thinking: Seriation"; "Exploring Children's Thinking: Conservation"; "Working with Children's Concepts"; "Using Toys and Games with Children"; "Developing Children's Sense Perception." (Author/SB)

Documents acquired by ERIC include many informal unpublished materials not available from other sources. ERIC makes every effort to obtain the best copy available. Nevertheless, items of marginal reproducibility are often encountered and this affects the quality of the microfiche and hardcopy reproductions ERIC makes available via the ERIC Document Reproduction Service (EDRS). EDRS is not responsible for the quality of the original document. Reproductions supplied by EDRS are the best that can be made from the original.

U.S. DEPARTMENT OF HEALTH, EDUCATION & WELFARE
NATIONAL INSTITUTE OF EDUCATION
THIS DOCUMENT HAS BEEN REPRODUCED EXACTLY AS RECEIVED FROM THE PERSON OR ORGANIZATION ORIGINATING IT. POINTS OF VIEW OR OPINIONS STATED DO NOT NECESSARILY REPRESENT OFFICIAL NATIONAL INSTITUTE OF EDUCATION POSITION OR POLICY

ED129464

PS 008888



LEARNER'S GUIDE

# exploring children's thinking: part 1, classification

2

THE FLEXIBLE LEARNING SYSTEM—COMPETENCY-BASED LEARNING UNITS FOR ADULTS IN EARLY CHILDHOOD EDUCATION

# EXPLORING CHILDREN'S THINKING
# Part 1.
# The Development of Classification

Preschool - Third Grade

by

Keith R. Alward

in association with

Allen E. Black
Chizu Iiyama
Frances K. Ruff
Harriet Shaffer

Drawings by

Carol Ann Ragle

Masako N. Tanaka, Director
Flexible Learning System

Far West Laboratory for Educational Research and Development
San Francisco

This learning unit is a product of the Early Childhood Education Program of the Far West Laboratory, San Francisco, a public, nonprofit organization supported in part by funds from the National Institute of Education, Department of Health, Education and Welfare. The opinions expressed in this publication do not necessarily reflect the position or policy of the National Institute of Education, and no official endorsement should be inferred.

Far West Laboratory for Educational Research and Development

1855 Folsom Street, San Francisco, California 94103 (415) 565-3000

Copyright © 1975, Far West Laboratory for Educational Research and Development. All rights reserved. Copyright for these materials is claimed only during the period of development unless authorization is granted by the National Institute of Education to claim copyright also on the final materials. For information on the status of the copyright claim, contact either the copyright proprietor or the National Institute of Education.

"PERMISSION TO REPRODUCE THIS COPYRIGHTED MATERIAL HAS BEEN GRANTED BY Far West Lab. for Educ. Research & Development TO ERIC AND ORGANIZATIONS OPERATING UNDER AGREEMENTS WITH THE NATIONAL INSTITUTE OF EDUCATION. FURTHER REPRODUCTION OUTSIDE THE ERIC SYSTEM REQUIRES PERMISSION OF THE COPYRIGHT OWNER."

# ACKNOWLEDGMENTS

Staff of the Early Childhood Education Program
(during development of this Unit)

Abrams, Allan
Alward, Keith
Biestman, Margot
Bödy, Bart
Brown, Judie
Chow, Stanley
Culang, Cecelia
DeAnda, Nat
De la Torre, Rosemary
Diaz de Leon, Josefina
Hay, Johnnie
Hubner, Judy
Lewis, Francione
Matteson, Rosary
Monroe, Jean
Rayder, Nicholas
Rice, Carol
Robinson, Margaret
Stewart, Ingjerd
Stripp, Steven
Tanaka, Masako
Tate, Emma
Taylor, JoEllyn
Taylor, Terry
Thoms, Pete
Winger, Joanne

SPECIAL APPRECIATION IS EXTENDED TO:

DR. MASAKO TANAKA, for her encouragement and for making this unit possible;

RICK MURISON and ED SARMENTO (FWL Media Division), for their skill, encouragement, and cooperation in production of the videotape series: The Growing Mind: A Piagetian View of Young Children;

THE STAFF of Hillside Primary School, Berkeley Ca., and the delightful children, for their cooperation in the production of the videotape series;

DR. JONAS LANGER, who has been a constant guide in my study of Piaget's work;

RUTH ECKLAND, who has worked with enthusiasm and care in editing the rough manuscript;

KATE BENNETT, who rendered a beautifully typed manuscript;

ALLEN BLACK, who contributed the greater portions of Chapter 4 and the Assessment Booklet;

CHIZU IIYAMA and HARRIET SHAFFER, who provided a rough outline of this book and who had the courage and patience to field test a preliminary version with their students; and to the students themselves who rewarded all of our efforts;

FRANCES RUFF, who took the first crack at writing this unit and in so doing, made everyone's task that much easier;

DR. MILLIE ALMY, for her helpful review of an earlier draft of this book;

CHET TANAKA, for the cover design.

## ABOUT THE AUTHORS

KEITH ALWARD holds a master's degree in educational psychology and is presently working on a Ph.D. dissertation at the University of California, Berkeley. He is interested in the social and intellectual development of children and its implications for early childhood education. During the last ten years he has extensively studied Jean Piaget's work in child development. In six years with the Laboratory, he has worked on a number of projects in the Early Childhood Education Program. These include: educational evaluation, research instrumentation, training, and the development of a number of units in the Flexible Learning System. He recently produced a series of four videotapes titled: The Growing Mind: A Piagetian View Of Young Children.

ALLEN BLACK is presently completing a Ph.D. dissertation in developmental psychology at the University of California, Berkeley. He has extensively studied the relationship between logical structures and moral thought in the transition between the concrete and formal-operational stages of development. He has taught courses in developmental psychology at the University of California, Berkeley and at Bakersfield State University.

CHIZA IIYAMA received her master's degree in education from the University of Chicago. She has been associated with the field of early childhood education in many capacities: parent, early childhood and college teacher, trainer and community services. She is presently head of the Department of Early Childhood Education at Contra Costa Community College, California.

FRANCES RUFF received her bachelor's degree in psychology from the University of California at Berkeley, graduating with honors, Phi Beta Kappa. She recently completed an Honors Thesis on the topic of classification in children. She is interested in developmental and educational psychology with an emphasis on young children's thinking. She has worked with children in a variety of educational settings.

HARRIET SHAFFER, M.A., is currently an instructor in Early Childhood Development, Los Medanos Community College, California. She directed the first low-income parent co-op in Northern California, has taught at California State University at both Hayward and Sonoma and has been active in early childhood education for the past 15 years. Her current interests include the development of experiential teacher-training and parent education. In the summer of 1975, she was a member of a delegation to the People's Republic of China where she was able to observe educational practices in the classroom.

# TABLE OF CONTENTS


**OVERVIEW** ..... xi

**PREFACE** ..... xiii

**INTRODUCTION** ..... xvii

PIAGET--THE PERSON ..... xvii

PIAGET'S VIEW OF KNOWLEDGE ..... xviii

STAGES OF DEVELOPMENT ..... xix

AN EXAMPLE OF STAGES IN INTELLECTUAL DEVELOPMENT: CONSERVATION. xxi

THE SOURCES AND DIRECTION OF INTELLECTUAL DEVELOPMENT ..... xxii

YOUR AND PIAGET'S EXPLORATION OF CHILDREN'S THINKING ..... xxvi

**CHAPTER 1: An Introduction to Classification** ..... 1

WHAT IS CLASSIFICATION ..... 1

A LOOK AT SOME OF YOUR OWN CLASSIFICATION SKILLS ..... 3

STAGES OF CLASSIFICATION ..... 10

DOING A CLASSIFICATION TASK ..... 21

**CHAPTER 2: Working with Children** ..... 35

INTERVIEWING A PARTNER ..... 35

WATCHING A VIDEOTAPE ..... 47

INTERVIEWING CHILDREN ..... 49

**CHAPTER 3: Assessing Stages of Classification** ..... 75

GENERAL REMARKS ON THE DEVELOPMENT OF CLASSIFICATION ..... 75

THE PRE-CONCEPTUAL STAGE--GRAPHIC COLLECTIONS (GENERALLY TWO TO FIVE YEARS OF AGE) ..... 76

THE INTUITIVE STAGE--NON-GRAPHIC COLLECTIONS (GENERALLY SIX TO SEVEN YEARS OF AGE)..... 84

THE CONCRETE-OPERATIONAL STAGE--TRUE CLASSES (GENERALLY BETWEEN EIGHT TO 12 YEARS OF AGE)..... 89

SOME CONCLUDING REMARKS ON STAGES OF CLASSIFICATION..... 91

LOOKING FOR STAGES OF CLASSIFICATION..... 92

ON-GOING ASSESSMENT..... 107

**CHAPTER 4: Additional Ways to Explore Classification with Children**..... 111

CLASSIFICATION BY TOUCH..... 113

VARIATIONS ON CLASS INCLUSION: "ALL AND SOME"..... 113

SUPPLEMENTAL GAMES AND MATERIALS..... 115

MULTIPLICATIVE CLASSIFICATION..... 117

VARIATIONS ON MULTIPLICATIVE CLASSIFICATION..... 119

**CHAPTER 5: Educational Implications** ..... 123

THE DEVELOPMENT OF CLASSIFICATION AND ITS EDUCATIONAL IMPLICATIONS..... 126

OPEN-RESPONSIVE EDUCATION..... 129

**APPENDIX A: Classification Materials** ..... 135

**APPENDIX B: Transcript of Videotape** ..... 149

**APPENDIX C: References and Additional Resources** ..... 157

SOME OF PIAGET'S TRANSLATED WORKS..... 159

PIAGET AS SEEN BY OTHERS..... 161

PIAGET'S THEORY AND EDUCATION..... 163

FILMS AND VIDEOTAPES..... 165

## TABLE OF ACTIVITIES AND FORMS


ACTIVITY 1: Some Word Games..... 3

ACTIVITY 2: Sorting Pictures--Adults..... 21

ACTIVITY FORM A 23

ACTIVITY 3: Sorting Pictures--Children..... 27

ACTIVITY FORM B 31

ACTIVITY 4: Class Inclusion Problems (beads)--Adults..... 35

ACTIVITY FORM C 37

ACTIVITY 5: Free Sorting (attribute shapes)--Adults..... 39

ACTIVITY FORM D 41

ACTIVITY 6: Structured Sorting (attribute shapes)--Adults..... 43

ACTIVITY FORM E 45

ACTIVITY 7: Viewing the Videotape--The Development of Classification..... 48

ACTIVITY 8: Class Inclusion Tasks With Children..... 57

ACTIVITY FORM C 59

ACTIVITY 9: Sorting Tasks with Children..... 63

ACTIVITY FORM D 65

ACTIVITY FORM E 69

ACTIVITY 10: Reviewing the Videotape..... 92

ACTIVITY FORM F 93

ACTIVITY 11: Sharing and Assessing Your Interviews..... 98

ACTIVITY 12: Demonstrating Three Stages of Classification..... 99

CHILD RECORD: CLASS INCLUSION 101

CHILD RECORD: FREE SORTING 103

CHILD RECORD: STRUCTURED SORTING 105

# OVERVIEW

This unit is composed of a preface, an introduction, and five chapters. Each chapter builds on and enriches what you will learn in the previous one. It is designed to be used with a trainer and a group of learners. There are 12 activities that serve as the backbone of the unit. You will do some by yourself, some with other adults, and some with children. These activities will help you clarify and integrate the ideas that you read in the text. It is important that you do the activities in order that you learn the contents of this book.

In preparation, allow 12 to 15 hours of class time to complete the unit. Six of these hours should be spent with young children (between four and eight years of age). You will need to start a collection of things that interest young children -- shells, rocks, miniature toys and animals, etc. You will use these in Activity 12 (page 99). Also, gather together some attribute blocks, wooden string beads, and a magazine to cut up for pictures. You will use these in Activities 3, 4, 5, 6, 8, 9, and 11. Be prepared for some surprises in the way children classify these materials.

When you have finished this unit, you will be able to:

- Demonstrate the difference between adult-thought and child-thought as seen in classification activity:
- Interview children to determine their methods of classifying and their stages of intellectual development;

- Demonstrate the differences in the way children classify within the graphic, intuitive, and concret erational stages of development;

- Develop a system for interviewing children and keeping records of your findings;

- Recognize how classification is involved in a wide variety of activities.

# PREFACE

If you plan to or are presently affecting the experiences of children, then you should learn about children's thinking. This book is part of a series called Exploring Children's Thinking. This series covers four areas of mental development between four and eight years of age: classification, seriation (order relations), number and measurement (quantitative relations), and spatial relations. The first three topics are covered by individual books (Parts 1 through 3) and by corresponding 30 minute color videotapes illustrating children's reasoning. The fourth topic (spatial relations) is covered by a fourth videotape.[1]

In reading through this book, you will explore the development of classification skills. Classification involves judgments about how things, including experiences, activities, and feelings, are similar and how they are different. We are not so much concerned with what children regard as similar or different, but rather, how children go about making and using such judgments.

If this is your first exposure to this topic, you will be surprised by what you learn. Below a certain stage in development children do not reason about classes in the same way adults do, no matter how they are taught or raised. Their classification skills, like their thinking in general, changes in fundamental ways as they develop. You will see that children at the same stage of development classify in similar ways, no matter what their educational or cultural experiences.

---

1. Videotape series titled: The Growing Mind: A Piagetian View of Early Childhood.

The topic of classification has always been important to the psychology of thinking and learning. All those who have thought about thinking have attributed importance to how the mind categorizes and sorts out similarities and differences. Every time we recognize something, or do the same thing in the same circumstances, we are engaging in classification. Whenever we think about what is true of all or part of some group of people, events, objects, and so forth, we are categorizing or classifying. Classification is a way of ordering and understanding our experiences.

In addition to the topic of classification, this book introduces the work of the Swiss psychologist, Jean Piaget. Piaget is internationally recognized as a leading authority on the character and development of children's thinking. He has shown with astonishing breadth and detail the nature of what children know and understand and how their understanding changes as they develop mentally.

Piaget's contribution lies not only in the numerous areas he and his co-workers have investigated, but equally important, in the method of investigation called "structuralism." Structuralism embodies not only a means of studying thinking and its development, but also a theory that guides the exploration and provides a framework for understanding what is found.[2] As you work through this book you will learn how to investigate classification in children and analyze your findings according to the methods of structuralism. This way of looking at thinking takes the observer beyond exploring facts that children may or may not know and focuses instead on the underlying pattern or organization of children's thinking.

---

2. Piaget, Jean, Structuralism.

As you learn to detect this pattern, you will find that what children know is not simply less than what adults know: it is fundamentally different; and what children of the same stage know is fundamentally similar.

Piaget has argued that children's understanding of physical causality, numbers, time, movement-speed-distance, probability, spatial relations, and geometry is also tied to a developing understanding of classification. The organization of similarities and differences and part-whole relationships, (which is what Piaget means by the expression "classification"), partially describes the organization of all forms of systematic knowledge.

To account for the relationship between classification and these many different areas of knowledge, Piaget has specified a number of types of classification.[3] This book focuses on a fundamental type concerned with the addition and subtraction of classes. In Chapter 4, you will be introduced through some interesting tasks to another form concerning the multiplication and division of classes: multiplicative classification involves crossing the properties of objects or events to produce new classes. Both forms of classification have a similar developmental pattern.

The Introduction of this book provides a brief description of Piaget's theory and some information about Piaget himself. In addition, it gives an overview of the ECT series and its relationship to Piaget's theory. Chapter 1 introduces the topic of classification and the characteristics of its

---

3. Flavell, J.H., The Developmental Psychology of Jean Piaget.

   Piaget, Jean, The Psychology of Intelligence.

   Inhelder and Piaget, The Early Growth of Logic in the Child.

   These works describe the various forms of classification structure as well as the structures of relations.

stages of development. Chapter 2 involves working with children to explore their classification skills. Chapter 3 provides a more detailed and theoretical description of the development of classification and the means of keeping records on the classification skills and the stages of the children you work with. Chapter 4 presents a number of additional activities with which to further explore children's understanding of classification. Chapter 5 provides a brief discussion of the educational significance of what you have learned about children's thinking and Piaget's theory. The Appendixes contain some materials that can be used in classifying activities, a transcript of the videotape on classification, and a list of resources for further exploring, not only the topic of classification, but much of Piaget's other work, and its relationship to educational process.

Now that you have a better sense of what this book is about, we can suggest ways it might help you as a teacher.. You will learn to look at children's thinking in a way that reveals its underlying order. You will come to appreciate the differences between how you and the child view the world. You will learn how to engage children in enjoyable activities that allow you to assess their developmental levels. You will come to see similarities and differences between children of the same age, and to find the underlying causes of some of the difficulties children may have with their schoolwork. Ideally, you will be better able to help children reveal their inner thoughts, and be better able to understand the nature of these thoughts. It is my hope that you find this exploration rewarding.



K.R.A., 1975

# INTRODUCTION

## PIAGET -- THE PERSON[4]

This book is one of a series of three dealing with Piaget's study of children's thinking. We selected Piaget's work as our focus because to date he has provided the most complete description and theoretical account of mental development in children.

Jean Piaget was born in Switzerland in 1896 where he has spend most of his life and continues to work. At twenty-two he received his Ph.D. in biology (a field in which he first published at the age of ten) and soon began work in the laboratory of Simon Binet, one of the founders of intelligence testing. While pursuing studies as a biologist, Piaget was developing a dominant interest in knowledge. He began to view its acquisition not as a set of facts and experiences, but rather as an evolutionary process in which knowledge was an outcome of how the mind organizes mental and physical activities. He proposed that the manner in which activities and experiences are organized goes through a series of regular steps or stages.

His early work in Binet's laboratory provided him with much information on the thoughts produced by children. He noticed regular inaccuracies in their thinking that were gradually eliminated with age. On the basis of three papers describing these common inaccuracies, Piaget at the age of twenty-five was made "director of studies" at the Institute J.J. Rousseau in Geneva. He continued his work at the Institute until 1940, at which time he was named Director of the Psychology Laboratory at the University

4. This Introduction appears in each book in the ECT series.

of Geneva. Along with numerous other posts and duties, Piaget is presently the Director of the International Center for Genetic Epistemology (Geneva), which he founded in 1956.

Throughout this more than fifty years, Piaget has been incredibly productive. He has produced well over two hundred works investigating numerous areas of human knowledge. He has virtually mapped the domain of intelligence from birth to late adolescence and has brought his nearly endless observations into a theoretical perspective drawing from logic, mathematics, physics, biology, psychology, and computer theory.

## PIAGET'S VIEW OF KNOWLEDGE

Piaget's theory has evolved in response to questions asked throughout history: "What is intelligence?" "How are universally true ideas derived?" "Is knowledge really no more than memory?" As the science of psychology developed, it addressed these issues, yielding two views. The first holds that we are born with particular ways of organizing experience, and that knowledge reflects these inborn patterns of organization. The second view is the behavioristic one that has dominated American psychology. It holds that knowledge is a copy of reality and/or learning from others. Piaget has brought a third view to bear, one that strongly suggests the inadequacy of the "inborn" and the behavioristic "copy" theories of knowledge.

As a biologist, Piaget formulated his view around three elements: the organism, the environment, and the interaction between the two.[5] From these

5. The term "environment" refers to those things that are outside the organism but which affect how the organism functions.

beginning elements come two biological processes that result in change. One is the process of acting on the environment, which is the same as incorporating the environment into actions. Piaget calls this "assimilation" of the environment to the organism. Grasping objects, recognizing a familiar object, and cooking dinner are ways we act upon our environment. The other process is an alteration in the organization of actions as a result of their use. Piaget calls this "accommodation," or the adaptation of actions to the environment. Learning to grasp differently, finding out that something is different than expected, modifying recipes for a meal are examples of how actions are modified through use. "Assimilation" and "accommodation" make up the dynamics of life -- all life being a process of acting on or taking in the environment with resulting changes in the actions themselves and their organization. Changes in the organization or structures underlying actions can be viewed as evolution or development.

Piaget sees knowledge as based in biology. He suggests that the underlying process by which an organism comes to survive is the same as that by which man can arrive at objective knowledge.[6] In both instances the process is composed of the assimilation of reality by the organism and a resulting change in the structures that assimilate. Mathematical thought and primitive biological processes are both based in action systems. The difference is one of the degree of development of those systems.

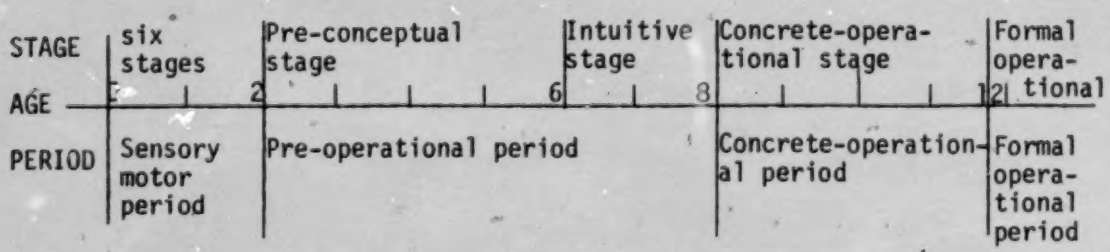
## STAGES OF DEVELOPMENT

Piaget is probably most widely recognized for his theory that children's

6. Knowledge that is universally accepted as provable and true.

thinking advances through a series of distinct stages. The essential aspects of a stage theory are that each new stage follows from and depends upon the completion of earlier stages, and that the sequence of development is the same for everyone. Piaget describes a stage in terms of how a child's thinking is organized. The thinking in earlier stages is less well organized than in later stages.

Piaget and his co-workers in Geneva, and a large number of researchers in other countries, have shown that children's thinking in a wide range of knowledge areas goes through a similar developmental pattern. This pattern is described by four major periods. During the first two years, the sensory-motor period, children progress through six distinct stages of intelligence. A second broad period, the pre-operational period, generally lasts between two and eight years of age. During this period, children develop their ability to represent reality with language, imagery, play, drawing, etc., and develop in their understanding of reality. The next period is the concrete-operational stage, during which children develop logical structures (from the adult's view) and apply them to a systematic understanding of a wide range of problems. By early adolescence children enter the formal operational period, considered to be the highest level of mental organization.



It is important to keep in mind that the age at which a child enters or leaves a stage is not specified by the theory. Children of the same age may be in different stages of development. What is so far shown to be true of all children is that all children go through the same series of stages, although not all children progress beyond the concrete-operational stage.

## AN EXAMPLE OF STAGES IN INTELLECTUAL DEVELOPMENT: CONSERVATION

One of the more familiar aspects of Piaget's work is the study of conservation. As adults, we recognize that a given amount of something does not change when only its shape has changed. For example, if you pour a tall glass of water into a short fat one, you know that the shape of the water may change, but its amount remains the same. This is called conservation.[7] Conservation is assumed by adults for anything that can be thought of in quantitative terms: a quantity of clay, a measure of distance, a unit of weight, a number of objects, a unit of volume, and so forth.

Piaget and numerous researchers throughout the world have shown that all children progress through the same sequence of stages in their understanding of conservation. Children in the pre-conceptual stage always think that changing the shape or arrangement of objects changes their amount. Children in the next stage believe that quantity is conserved under some circumstances, but not others. By the concrete-operational stage, children firmly believe that changes in shape, arrangement,

7. See The Development of Quantitative Relations, Part 3 of the ECT unit --a unit of the FLS

and appearance do not change amount. Furthermore, all children conserve substance (amounts of clay, rice, water, etc.) before they conserve weight (understand that the weight of something does not change when its shape changes); and all children conserve weight before they conserve volume (understand, for example, that a quantity of clay will displace the same amount of water even if the shape of the clay is changed).

## THE SOURCES AND DIRECTION OF INTELLECTUAL DEVELOPMENT

Although conservation is only one of many areas of knowledge examined by Piaget, it provides a focus for discussing his theoretical views on how knowledge is acquired.

It has been widely understood that memory, associations between one experience and another, sensory impressions, trial and error learning, and imitations of others, all play a role in thought and affect what we learn. However, each of these, singly or in concert, cannot account for what Piaget and others have found to be true of children's intellectual development. For example, the fact that children think an amount of liquid changes when it is poured, cannot be attributed to a poor memory, to experience, or to the teaching of others. While it is surprising to find children making such judgments, all children think this way at some point in their development.

On the other hand, all children eventually come to know that amounts are conserved, and they do so after passing through the same sequence of earlier stages. When asked why an amount of liquid stays the same when it is poured into a wider container, the conserving child almost universally gives one of the following arguments: "Nothing was added or taken away, so

it's still the same." "The water is now wider than before, but it is also not as tall." "You could pour the water back into the glass and it would be the same as before." These are logically precise arguments for why the amount has not changed even though it looks different. The question naturally arises as to how children come to reason in such systematic terms.

The arguments given by children for why amounts are conserved provide the basis for suggesting some of the likely and unlikely sources of objective knowledge. For example, consider the argument that if nothing is added or subtracted, amounts stay the same. It's easy to imagine that such a principle might be taught, or that it might be experienced through counting activities. However, it is well known that it is virtually impossible to teach this principle to pre-conceptual children; also, children in the intuitive stage either already know or can be taught this with respect to counting, but they do not necessarily apply the principle to other areas of conservation, such as substance and length.[8] Furthermore, all children arrive at an understanding of this principle irrespective of whether it is taught. The intuitive child must be repeatedly convinced of its truth, whereas children a few months older regard it as an obvious fact of nature.

Children who spontaneously understand that amounts do not change when nothing is added or subtracted may just as easily express the argument that liquid poured, for example, from a tall narrow glass into a wide one is conserved, because the water level is now lower, but further around, or wider. This expresses an understanding that changes in one dimension (height) can be compensated by those in another (width). It is unlikely that this principle of compensation was ever taught to most children who express it.

---

8, Siegel, Irving and Hooper, Frank (Eds.), Logical Thinking in Children: Research Based on Piaget's Theory.

Without measurement there is no way to tell that changes in one dimension compensate those in another, and the ability to measure, itself, follows rather than precedes an understanding of conservation. When children express an argument of compensation as their basis for conserving, they are simply expressing what they know must be true. As you will see, the argument of compensation is an important clue to their basis for conserving.

A third argument typically given is that if a quantity changes in appearance, there must still be the same amount because it can be changed back to its original appearance. This can be experienced directly. You can pour a glass of water into a bucket and pour from the bucket back into the glass and witness that there is as much water as when you started. But here is an interesting fact. While children may experience this from their first water play on, and while it may even be pointed out to them, this observation does not lead them to conserve. It is not until very close to the concrete-operational stage that such repeated demonstrations lead to an idea of conservation. And, again, children a few months older come to invent this principle for themselves.

The above arguments suggest that an understanding of conservation does not result from experience alone, whether that experience is manipulative and/or social. Piaget has argued that social experiences, physical experiences and maturation (physical growth) are necessary to intellectual development. But they alone are not sufficient to account for something as simple and obvious to adults as conservation.

Piaget has suggested two additional factors that underlie the source and direction of intellectual development.[9] One of these is the coordina-

9. Ripple, Richard and Rockcastle, Vern N. (Eds.), Piaget Rediscovered: A Report of the Conference on Cognitive Studies and Curriculum Development.

tion of actions and the other is the tendency of this coordination to become reversible.

The concept of a reversible coordination of mental actions is abstract and foreign to most of us. We can give some sense of its meaning by returning to the arguments given by children for conservation. One of the arguments is that a quantity is conserved if nothing is added or taken away. The concept of addition is a mental activity of joining things together. Subtraction is a mental activity of separating. When it is understood that subtracting amounts can exactly compensate adding amounts, then these two mental activities are in a reversible relationship to one another. Such a relationship makes it possible to reason that adding and/or subtracting lead to changes in amounts, and that doing neither leaves amounts the same or conserved. A similar expression of reversible reasoning is demonstrated in the understanding that changes in one dimension can compensate those in another. Changes in height, for example, are reversibly related to changes in width. It is therefore possible for an amount to change in one way and still be the same, because the first change is compensated by a second change. Reversible reasoning is likewise expressed in an understanding that a quantity can be changed in appearance and then changed back to its original form.

Children's understanding of conservation and their supporting arguments do not reflect things that have been taught or recorded from experience. Unlike facts, experiences, or things taught, the principle of conservation cannot be forgotten any more than one can forget that one's brother (sister) also has a brother (sister). Conservation is a product of reversible reasoning applied not just to objects, but to actions upon objects and, more importantly, to internal or mental representations of

actions. An understanding that actions (adding, pouring, narrowing, lengthening, etc.) can be reversed, inevitably results in a conception of conservation which itself is central to all measurement and all conceptions of units. Numbers themselves are simply abstract representations of units that can be counted and separated. And at its core, a unit is no more than a conception of an amount that is conserved in spite of spatial displacements -- changes in arrangements, appearances, and so forth. An ability to conserve is evidence that a child has achieved reversible thought and is capable of thinking of quantity in terms of units that can be measured.

## YOUR AND PIAGET'S EXPLORATION OF CHILDREN'S THINKING

By eight years of age most children begin to evidence dramatic changes in much of their thinking. Piaget and his co-workers have provided a description of these changes in a wide range of areas and have proposed that the emergence of reversible thought is a primary factor in the nature of these changes.

The majority of Piaget's work has concerned "objective knowledge:" knowledge that is subject to proof through agreed-upon arguments. For example, one can prove by the agreed-upon argument of counting, that eight blocks will remain eight blocks, even if their arrangement is changed. There is a range of similar problems that concern areas of quantitative reasoning other than conservation. Some of these are: time, speed-distance-movement, probability, proportionality, geometry, density, force, pressure, and velocity.

In Part 3 of this volume on Exploring Children's Thinking (ECT) we

focus on children's developing understanding of the conservation of number, substance, and length; measurement of distance; and the relation of time, speed and movement. Part 3 consists of a learning unit containing guidelines for exploring children's quantitative thinking and a 30 minute videotape demonstrating the methods of investigation and the developing character of quantitative thought between four and eight years of age.

Other subjects investigated by Piaget are not concerned with quantification. For example, Piaget has studied the understanding of space from early infancy to late adolescence. At some points an understanding of space uses quantitative concepts and at other points it does not. For example, geometry uses units to describe space. A square contains four equal straight lines connected at end points to form an enclosed space. The concepts "four" and "equal" are statements about units and are thus quantitative. However, space can be described without units. For example, the notion of an "enclosed space" does not use any quantitative units.

Part 4 of ECT concerns Piaget's investigation of developing spatial concepts in children between four and eight years of age. Again, we see the same stages as revealed in quantitative thought. Part 4 consists of a videotape demonstrating the methods and results of interviewing children between four and eight years of age on their concepts of straight lines, left-right and foreground-background orientations, and horizontal spatial orientations as demonstrated by the surface of a liquid.

Piaget argues that the similar pattern of stages in quantitative and spatial reasoning results from the general underlying tendency of mental activity to become increasingly organized and reversible. He has attempted to analyze, in terms of reversible classifying and sequencing activities, all that he has demonstrated in spatial and quantitative reasoning, as well

as other areas such as causality and genealogical relations.

In Parts 1 and 2 we explore the development of classifying and sequencing in children between four and eight years of age. Because of the importance attributed by Piaget to these two topics, we have provided a book for each. Part 1 presents a detailed description of the developing understanding of classification and how to explore this development with children. In Part 2 we likewise treat ordinal relations, or the logic of sequences. Each book is accompanied by a 30 minute color videotape.

The topic of classification concerns the coordination of judgments about how objects and events are similar and/or different, and the logic of some and all. For example, all cats and dogs are animals. Because all of the cats are only some of the animals, there are logically more animals than cats. Piaget argues that the logic of classification is based upon a reversible coordination between combining and separating activities; and that prior to the concrete-operational stage, this reversibility is absent, giving the young child's concepts an illogical appearance. However, it is wrong to call the classification of pre-operational children illogical. It is different from adult thought, yet systematically organized and consistent in its application.

The second topic, ordinal relations, concerns how children coordinate judgments about such things as before-after, first-next, less than-greater than, shorter than-taller than, and so on. Here, as well, there is a logic as expressed in the following: If Steve is older than Leon, and Steve is younger than Pete, then Leon is the youngest. Piaget describes this logic as the reversal of relations such as: If Steve is older than Leon, then Leon is younger than Steve.

Piaget's analysis of knowledge is complex. Some parts are more under-

standable than others and some are more worthwhile to the practicing educator. In this volume on children's thinking we attempt to guide you in a first-hand exploration of part of what Piaget has observed in children's thinking. In pursuing the reading, interviewing, and discussion activities, and by viewing the videotapes, we hope to stimulate not only an appreciation for the character of children's thinking, but a way of looking at thinking itself.

As you work through this volume, you will gradually gain new lenses through which to look not only at children's thinking, but at your own as well. If this topic sparks an interest, you will come to sense the broad patterns of commonality that touch upon a wide range of understandings. In another unit of the Flexible Learning System we help you prepare for exploring children's concepts in general.[10]

Educators commonly ask about the implications of Piaget's theory for education. We address this issue in the concluding chapters of Parts 1 and 2. However, a general view can be expressed quite briefly. Any significant educational implications from Piaget's theory are to ultimately be decided by educators who have come to experience the character of reasoning revealed by Piaget's methods. To translate Piaget's theory to educational prescription must be preceded by an appreciation of what he has discovered. This is the function of the ECT volume.

---

10. Alward, Keith R., Working With Children's Concepts, a unit of the FLS.

# CHAPTER 1

## AN INTRODUCTION TO CLASSIFICATION

### WHAT IS CLASSIFICATION?

Classification involves reasoning about similarities and differences. When we talk about a class of objects or events, we are talking about things that are similar. All the things in a class have at least one common property. However, the elements or members of a class, those things that are grouped together, may vary in terms of how similar they are. For example, we could have a class of dinner forks or a class of all types of forks. Both are classes, but they vary in the degree of similarity among the things grouped together. Dinner forks are more similar to each other than they are to pitchforks. Among elements of a class, differences and similarities can exist simultaneously.

When we talk about a class of things, we automatically imply that they are different from something else. For example, the class of eating utensils is different from things that are not eating utensils. Yet many things that are not eating utensils are in other ways similar to them. For example, eating utensils are different from cars but also similar in that both are made and used by people. It would be perfectly all right to put cars and eating utensils together and call it a class. If we were asked to describe the class, we'd say, "It's some of the things made and used by people." If we meant the class to be all of the things made and used by people, then we'd have to include airplanes, TV's, houses, and all the other things that people make and use.

The way in which all things in a class are similar to each other is called the class intension. "Intension" simply refers to the properties of the class or the things that are similar about everything in the class. You might think of it as the class name. "Dinner forks," "forks," "eating utensils," "objects made and used by people," are the intensive properties of our example classes. All classes have an intension, that is, there is some way in which all the things in a class are similar.

Another property of classes is the fact that all classes have something in them. This is called the class extension.[11] If the intension of the class is such that everything must be a dinner fork to belong, then the extension is such that all dinner forks could be put into the class, but salad forks, butter forks, pitchforks, etc., would be excluded. If the intension of a class were "all things made and used by people," then the extension of the class would include TV's, cars, airplanes, etc.

In order to understand what classes are and how they relate to thinking, we must realize that we can never simply talk about a single class. There are always relationships between classes. The things in a class can always be divided into further classes and/or included within other classes. In order to determine a class, one needs to consider its relation to other possible classes. This point will become clearer as you work through this unit.

---

11. "Extension" refers both to the possible members of a class and the actual members of a specific class. When intension and extension are coordinated with one another, all the things with the intension of the class are contained in the class.

## A LOOK AT SOME OF YOUR OWN CLASSIFICATION SKILLS

### Activity 1: Some Word Games

The purpose of this activity is to give you a personal sense of the relationships among classes. You can do these activities by yourself, although they may be fun to share with others. There are five sub-activities, each with a follow-up discussion concerning some of the class relations illustrated by the activity.

INSTRUCTIONS FOR ACTIVITY 1:

In each of the following sub-activities (A-E), there are two words paired together. You should try to think of something that is true of both words. For example, AIRPLANE-KITE: things that fly.

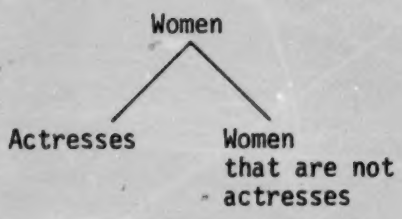
1A.

1. Suzie-Jane: _____
2. Ford-VW: _____
3. John-Joe: _____
4. Seagull-Hawk: _____
5. Jane-Marilyn: _____
6. VW-Toyota: _____
7. Lyndon-John: _____
8. Duck-Seagull: _____

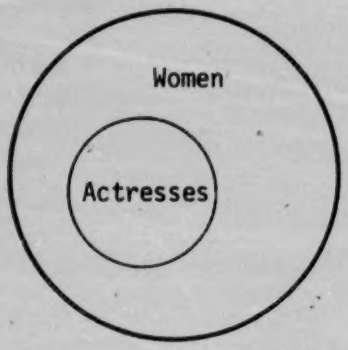
FOLLOW-UP TO ACTIVITY 1A (Read after completing 1A):

Here are some of the classes that people generally think of when we present the word pairs in list 1A: "girls/women," "cars," "boys/men," "birds," "movie actresses," "foreign cars," "Presidents of the U.S.," "water birds."

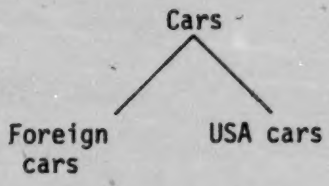
This simple exercise illustrates one type of relationship between classes. It is called an inclusion relation because classes include other classes. For example, "actresses" are included in the class of "women,"

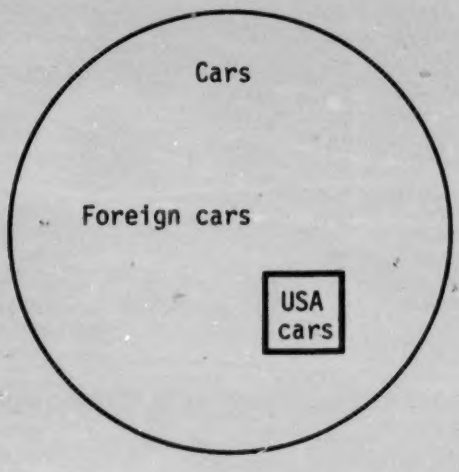



OR




As another example, you might have said "cars" for pair 2. VW's are cars. But in pair 6, you might have said that VW's belong to the class of "foreign cars." All foreign cars are included in the class of cars.



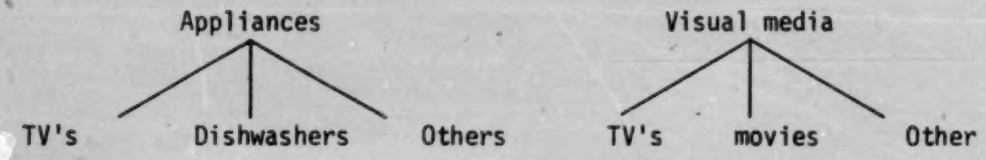



1B.

TV-Dishwasher: _____

TV-Movies: _____

For these two pairs, it's quite likely that you thought of classes like "household appliances" and "things we watch for entertainment, news, etc." Here the same object, "TV," is thought of as belonging to two different classes because it is thought of in different terms. This illustrates, again, the fact that things can belong to different classes at the same time and that these classes do not necessarily include each other. All appliances are not visual media and vice versa.




Name two other appliances

_____

_____

Name two other visual media

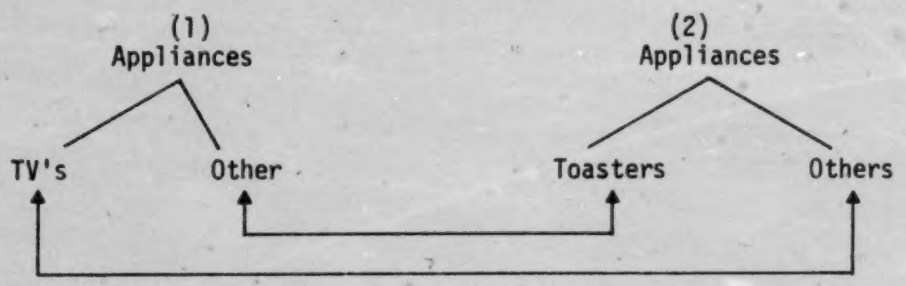
_____

_____

A somewhat different class relation is illustrated by the following:

1. Some appliances are TV's and some are not.
2. Some appliances are toasters and some are not.

These two statements together look like this:



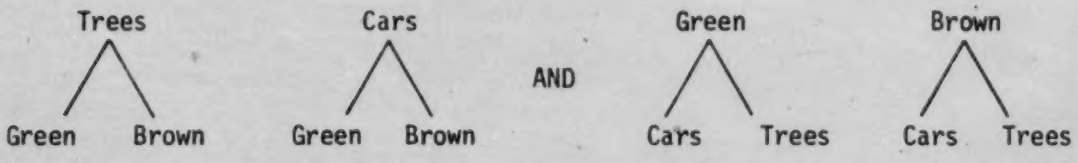
In (1), the class of "other" (appliances that are not TV's) includes the class of toasters because some of the appliances that are not TV's are toasters. In (2), the class of "other" includes the class of TV's because some of the appliances that are not toasters are TV's.

1C.

Brown tree-Green tree: _____

Brown car-Green car: _____

It's most likely that you come up with the classes "trees" and "cars." But if you consider both pairs, you might come up with the classes "things" and "colors." The relation between both pairs look like this:




These types of class relations are often illustrated by a matrix such as the following:

| | | THINGS: CARS | THINGS: TREES |
|---|---|---|---|
| COLORS | GREEN | | |
| | BROWN | | |

1D.

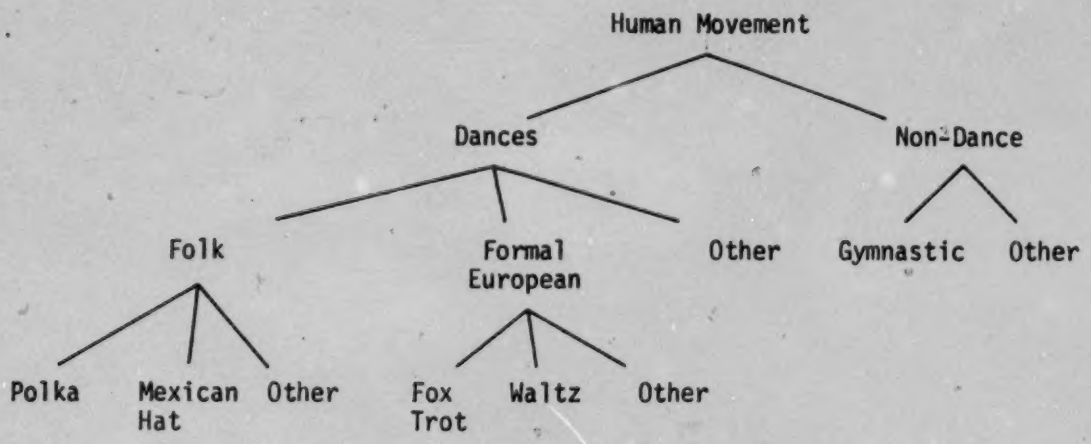
Folk Dance-Fox Trot: _____

Gymnastics-Folk Dance: _____

Polka-Mexican Hat Dance: _____

Fox Trot-Waltz: _____

Some responses to the above pairs might be: "dances," "human movement," "folk dances," "formal European dances." The following is an illustration of some of the relations between these classes:

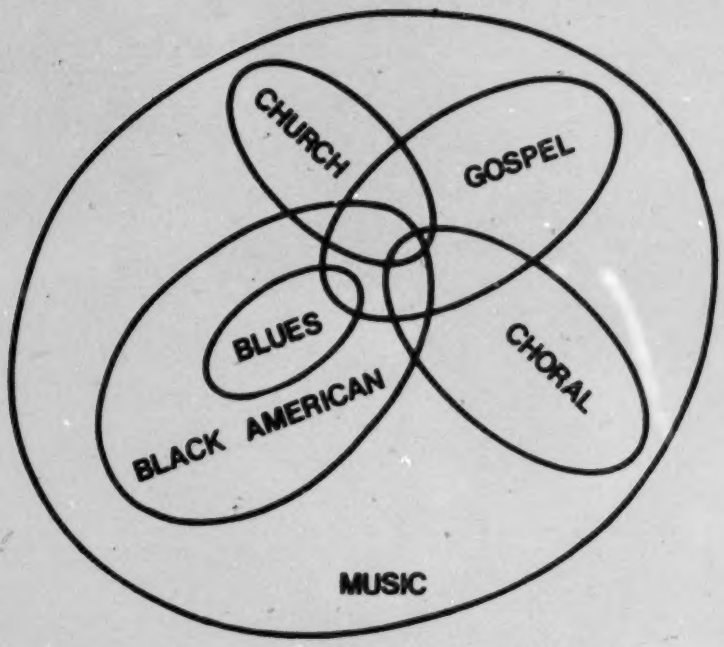



1E.

Gospel-Blues: _____

Choral-Gospel: _____

For the above two pairs, you might think of the classes "Black American music," and "church music." This is one of the ways the relationships between these classes can be illustrated:




If you considered some of the relations between these classes, it would be possible to make the following statements:

1. Gospel, blues and choral are all types of music.
2. Some church music is gospel, some choral, and some is neither.
3. Some choral music is Black American, some is church, some is neither.
4. Some church music is Black American, some Black American music is gospel, some is neither.
5. Some gospel music is church music, some is Black American music, some is both, and some is neither...and on and on.

DISCUSSION OF ACTIVITY 1:

Although you may not have generated the same classes (e.g., "movie actresses," "foreign cars," folk dances"), you are able to recognize that they are legitimate classes and could explain why or under what circumstances it's legitimate to say for example that "cars" is a class into which both VW's and Fords can be placed, and that VW's are also foreign cars, which Fords are not. This is a form of reasoning that distinguishes adults from children. Children have difficulty reasoning about the relationships between classes, e.g., that VW's are some of the foreign cars; that some foreign cars are not VW's; that all foreign cars are cars, but that some cars are not foreign. They cannot, simultaneously, incorporate "the parts" and "the whole" in their reasoning. If a child is given ten cars that are recognizably foreign to him/her and three cars that are recognizably U.S. made, and is then asked, "Are there more foreign cars or more cars?" The response will be "more foreign cars." The child sees that there are more of that part than the other part, U.S. cars. S/he does not think in terms of cars as a more comprehensive intension that includes in its extension the more limited class of foreign cars. The adult takes this sort of reasoning for granted.

We can also understand how the same thing can belong to a number of different classes that do not include one another. In this respect, the adult again thinks differently than the child. For example, TV's belong to the class of appliances, and to the class of visual media. We could reason that some appliances are also forms of visual media and some are not; and that some of these are TV's and some are not (e.g., slide projectors); that some forms of visual media are appliances and some are not (e.g., paintings)

and so on. The young child cannot follow these arguments even when they involve physically sorting objects.

It must be emphasized that these differences do not concern just being able to state or follow statements about the relationships between TV's and appliances. What they do concern is the very foundation of thought, the reasoning necessary to the formation of concepts. A concept, such as the concept HOUSE, ultimately requires some notion about what is true of all things called "houses," or what must be true for something to be an example of the concept "house." To know how all of the members of any concept or class are the same, requires knowing how all of the members are also different from other classes and, for example, how some houses are also similar to other things that are not houses (e.g., skyscrapers). That is, a well-formed concept requires the ability to coordinate the relationships between "all and some" with similarities and differences. All of the above examples boil down to this issue, and this is precisely what children between two and four or five years of age cannot do. That is why they are said to belong to the "pre-conceptual" stage. While they certainly have concepts, they are not of a well-formed nature. Children in the next stage, the intuitive stage, know how all the things of some classes or concepts are alike, at least when concrete objects are involved. But the intuitive child still fails to coordinate the relationships of all and some with similarities and differences in the consistent fashion typical of older children.

## STAGES OF CLASSIFICATION

Between birth and adolescence, children's thinking progresses through a number of stages, and these stages are clearly revealed in the nature of

the child's classification abilities. In fact, Piaget has argued that it is the development of classification that underlies the development of the child's thought in general.[12, 13]

This unit concerns children between four and eight years of age. In the following, a brief introduction will be given to three stages of classification generally seen during this period.

## GRAPHIC COLLECTIONS (GENERALLY FOUR - FIVE YEARS OF AGE)

Most children between four and five years of age are still in the pre-conceptual stage of intellectual development. During this period the child's classifications are called graphic collections. The pre-conceptual stage is a long stage, emerging somewhere abound two and generally lasting to about five years of age. Children must first pass through earlier stages or ways of thinking before arriving at the pre-conceptual stage, and when they leave this stage, they always enter the next stage, called the "intuitive stage." There is, however, no absolute relationship between the age of a child and the stage s/he may be in.

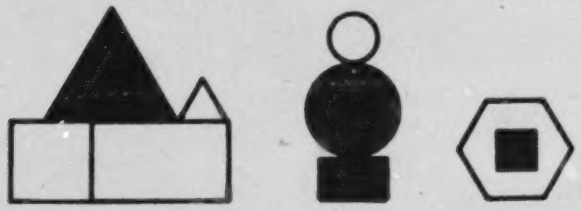
To illustrate the pre-conceptual stage, let's imagine a task in which a child is given a number of different colored shapes to classify.

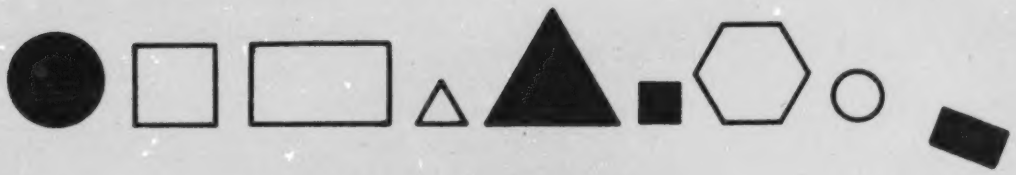
12. Inhelder, Bärbel, and Piaget, Jean, The Early Growth of Logic in the Child.

13. "Relations," covered in Part 2 of ECT, are considered by Piaget to be equally important to thought.

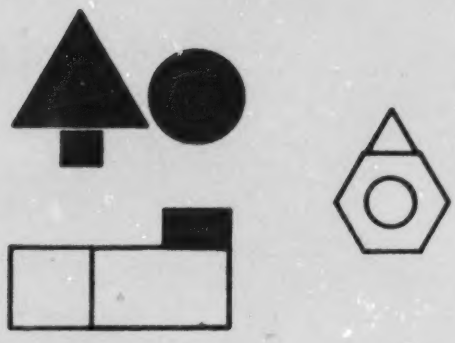
After the child becomes familiar with the materials, s/he is asked to "Put together the ones that are alike." In response to these instructions, children in this stage form graphic collections. The term "graphic" means that the child forms collections of objects that form a visual whole, a picture or pattern, rather than considering the similarities and differences between properties of objects.

Here are some examples of graphic collections:

A. 

B. 

C.

D. 

The two significant things in all four examples are these:

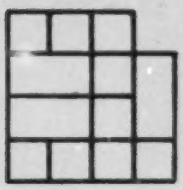
1. In each case (A-D), the child is concerned with the arrangement of the objects.

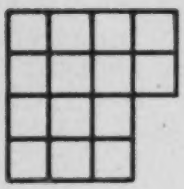
2. In each case, either there are:

   a. No classes or collections in which all the things are the same -- no class intension (examples A, B)

   OR

   b. There are a few groups in which all the things in the groups are similar, but not all the things which could belong to the group are in it (D), or the similar things are together because of the pattern they form (C). A common example is for children to put a number of rectangles or squares together because they fit together nicely.





There is nothing wrong with forming visual wholes, patterns, and so on. Great paintings and great architectural achievements are visual wholes. But the child's thinking is different. The child thinks "being alike," "being similar," "having something in common," "being the same," are all equivalent to saying that all the parts of a picture are the same because they are parts of the picture. Now we reason like this ourselves. For example, we might say all the parts of a car are alike because they belong to cars, because they go together to make up a car. But we could also think of the wheels, for example, as being similar to each other, and similar to the wheels on other cars; we could think of various types of cars

being similar to or different from each other or think of all the parts belonging to the classes of metal, rubber, plastic, and glass. That is, we can reason about how all of some things are similar to each other but also different from other things. The child sim[illegible] does not reason about similarities and differences. The pre-conceptual child makes things similar by arranging them so that they form a whole, an object.

This characteristic of the pre-conceptual child's thinking is not just an issue of what the child does with a bunch of blocks when s/he is asked to sort. Graphic reasoning has been shown to also be true in a number of other areas of mental activity. Asking a child to sort blocks is just one of the ways that we can see this characteristic. It is a simple and revealing technique.[14]

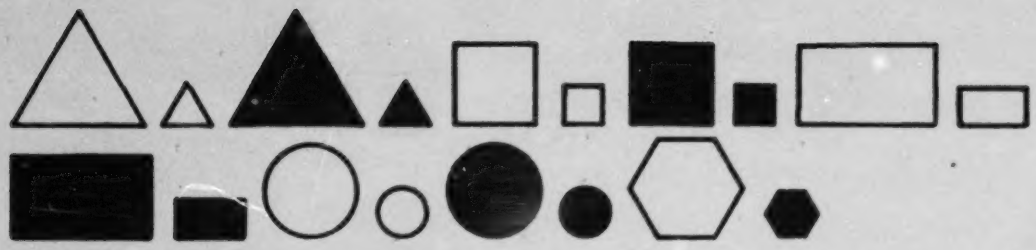
## NON-GRAPHIC COLLECTIONS (GENERALLY SIX-SEVEN YEARS OF AGE)

Most children between six and seven years of age are still in the intuitive stage of mental development. During this stage the child's classifications are called non-graphic collections because they take into consideration the similarities and differences among objects. The child no longer thinks of "similar" solely in terms of "belonging together" as part of a graphic or visual whole.

Here is another set of shapes (attribute blocks) that might be used to assess classification skills:

---

14. Parts 2 - 4 of the ECT series explores the same tendency of the child to think graphically in other types of activity. The unit, Working With Children's Concepts, explores the issue of children's concepts in general.

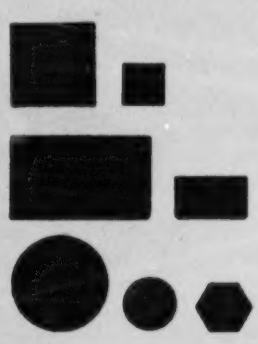


This set of materials is less complex than those generally used. In addition, the real insight into the child's classification comes from seeing both how the classes are formed and how the child responds to questions and additional problems posed by the adult. Our purpose here is simply to point out some of the main features that characterize particular stages of development.

Examples of non-graphic collections:

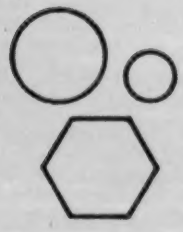
E.

1

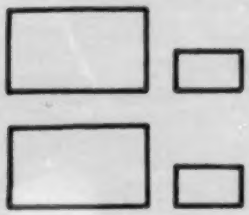


2

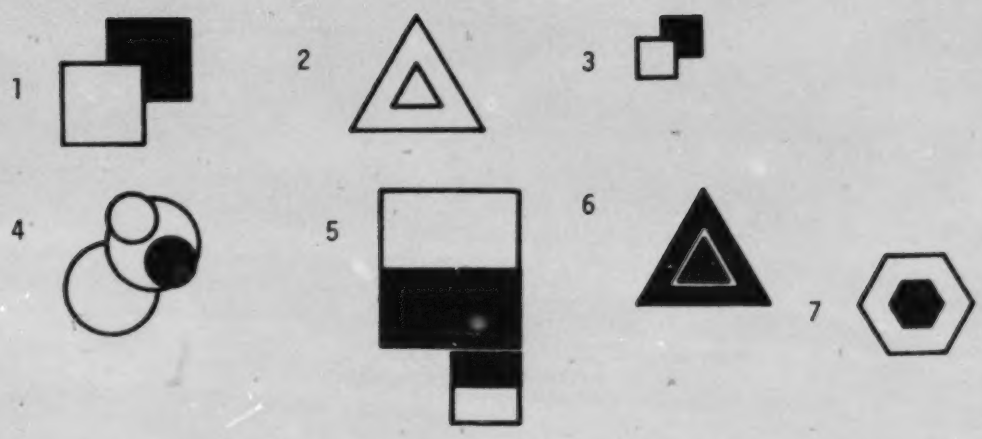
3



4



F.




There are two ways in which these examples of non-graphic collections are more systematic than the classes of the pre-conceptual child:

1. All the classes in examples E and F have an intensive property. In E1 it is "color," in E2 it is "triangle," in E3 it is "color," and in E4 the objects are grouped together because they are the same color and shape.
2. Visual arrangement alone does not determine which objects go together.[15]

There are also two ways in which the examples show that the intuitive child's classes are less sophisticated or less well-organized than those of children in the next stage, the concrete-operational stage.

1. Extension is not coordinated with intension. For example, in E one of the classes (E1) is all dark objects. However, some dark objects are in E2 as well.

---

15. However, children in the intuitive stage are often concerned with arrangement of objects within the class and, on occasion, produce graphic collections just as adults sometimes do.

2. The child's use of intension, the similarities and differences defining the classes, is inconsistent. For example, in F, some of the shapes are put together because they are the same shape and the same size (F1 and F3). Others are together because they are the same shape and color (F2 and F6), and others because they are the same shape only (F4 and F5).

The intuitive child's inability to coordinate intension and extension, and the inability to use intension consistently affects his/her ability to reason. Being able to coordinate intension and extension, and being able to clarify intension,underlies the logic necessary to form consistent concepts. For example, if I were to ask you how all forks are alike, you might say they have points. If I asked if all things with points are forks, you would say "No." You know that needles, knives, and a number of things with points are not forks. That is, forks are only some of the things with points. If I asked, "Are there more things with points or more forks in your kitchen?" you'd say, "More things with points" because you know that some of the things with points are not forks. As you will see, children in the intuitive stage do not reason in such a consistent fashion.

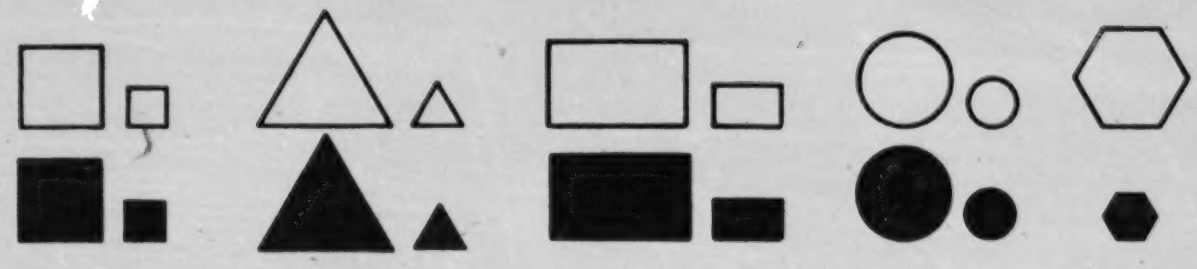
## THE CONCRETE-OPERATIONAL STAGE (GENERALLY STARTING BETWEEN SEVEN AND EIGHT YEARS OF AGE)

The last stage to concern us, although the child's ability to handle the relations between classes continues to develop, is the concrete-operational stage. Children in this stage classify objects in a way that is essentially indistinguishable from the way adults classify. Most children between seven and eight years of age start showing some of the characteristics of this stage. However, concrete-operational reasoning is not well-

developed until late childhood, around 11 or 12 years of age.

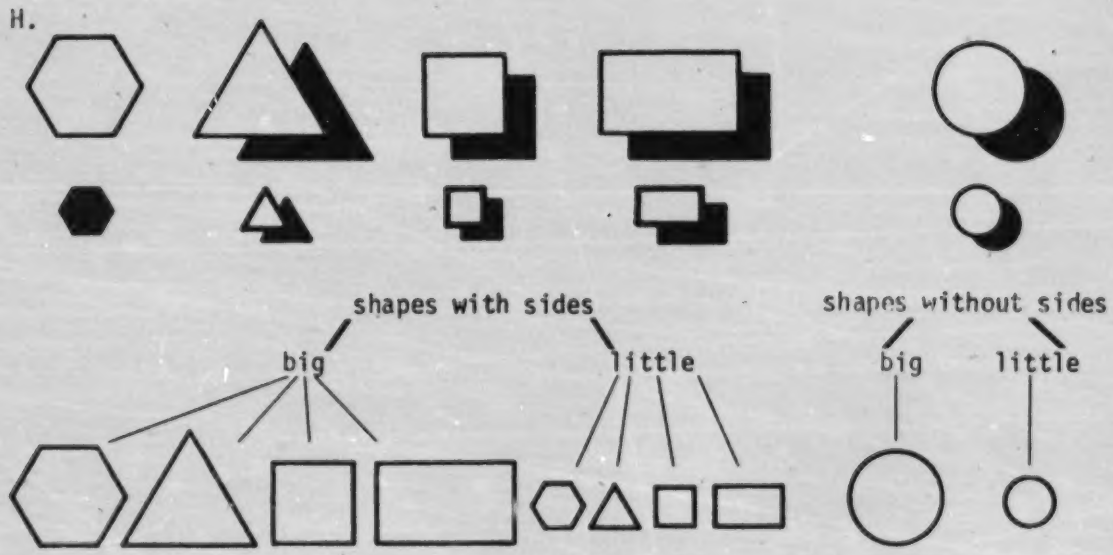
Here are some examples of how a concrete-operational child may classify the same shapes used earlier to illustrate the intuitive child.

G.



1 2 3 4 5

H.




There are a number of ways in which the classifications of the concrete-operational child are better organized than those of the pre-conceptual or intuitive child. By talking with the child, and by posing a variety of different classification problems, we would clearly see a greater number of

refinements in the concrete-operational child's classification abilities.

Here are some significant points about the above examples:

1. All the classes in examples G and H have intension coordinated with extension. That is, all the elements in each grouping are similar in some way, and all the things with that intension or property are grouped together.
2. The intensions, the similarities and differences within and between classes, are well-coordinated and often complex, as the diagram for example H shows.
3. All the objects in both G and H are simultaneously classified in a number of ways. That is, each element is understood to belong to a number of classes at the same time. In G, it is clear by the arrangement that all the shapes are understood to belong to three classes at the same time; color (light-dark), shape (triangle, square, etc), and size (large-small). In example H, all the objects are understood to belong, at the same time, to the class of shapes with sides, to the class of big or small shapes and to either the class of squares, triangles, or circles, etc. This is called class multiplication.

The general pattern or sequence of development as we have outlined it has been shown to be characteristic of children throughout the world.[16] These findings tend to support Piaget's theoretical claim that experience, in the specific sense of being taught how to classify, is not the underlying cause of this common pattern. However, it should be noted that what

---

16. Dasen, Pierre R., Cross-Cultural Piagetian Research: A Summary.

can be taught or, more accurately, instilled by culture is the basis of intensions, the perspective from which things are viewed as being similar to or different from each other. The child of a Bedouin nomad might place a dog and a camel in the class of domestic animals; whereas a Brooklyn grocer's child might place dog and cat in the domestic animal class, and camel with lion in the class of zoo animals. Even simple graphic collections are influenced by the cultural context; a pattern that is interesting to a fisherman's child might not be so to a child living in a desert.

Naturally, the issue of classification is not simply one of what we choose as our basis for saying things are similar or different. Classification ultimately concerns the ability to reason about the relationship between classes, to coordinate intension and extension and to think about similarities and differences in a consistent fashion. The fact that these coordinations are not seen in children prior to the concrete-operational stage indicates that the child's concepts and the child's thinking are markedly different from that of adults.

**Activity 2: Sorting Pictures — Adults**

In this activity you will collect about 20 pictures to sort into groups of things that are similar. After you have sorted them, you will have a partner do likewise and then compare both your results. The purpose of the activity is to give you a first hand experience with some of the thought processes that one goes through in classifying. In addition, you will see how other adults classify in ways that are similar to you, but also different from you.

MATERIALS:

A magazine, scissors, a partner.

INSTRUCTIONS FOR ACTIVITY 2:

1. Pick a magazine that you are willing to cut up. Pick one with a large number of pictures, preferably photographs of actual things. Advertisements are a good source.
2. Go through the magazine and cut out at least 20 pictures that catch your attention. Cut out single objects, i.e., pictures of one thing or a picture of things that are all similar, e.g., a group of people.
3. Use Activity Form A for completing the activity.
4. Put together pictures that are alike in some way. Make as many classes as you can, making sure that things that are similar are put together. Write down what the classes are and what's in them.

For example,

| Class name | Pictures in group |
| --- | --- |
| Animals: | dog<br>cat<br>lion<br>elephant |

5. Without changing your groups, try to combine some of them to make as few classes as possible (but at least two). Write down the new class names.
6. Now mix up all the pictures and re-classify them, trying not to use any of the class names you used in Steps 4 and 5. Write down the names of your new classes. (Making a few classes is probably easier than forming many of them.)
7. Exchange your pictures with your partner and repeat Steps 4 through 6.
8. Discuss the activity with your partner or with a group of other learners.

   Focus on:

   a. Sharing the classes you and your partner formed.
   b. Discussing how you and your partner were similar in your approach and the nature of the classes you formed. Discuss how you were different as well.
   c. Discuss what kinds of decisions, difficult and easy, you had to make in completing the task.

ACTIVITY FORM A: Sorting Pictures - Adult

NAME: _____

DATE: _____

To be used for Activity 2, page 21

1. After you have selected your 20 or so pictures, put together pictures that are alike in some way. Make as many classes as you can -- making sure that things that are similar are put together. Write down what the classes are and what's in them.

| CLASS NAMES | CONTENTS OF CLASSES |
|---|---|

2. Without changing your groups, try to combine some of them to make as few classes as possible (but at least two). Write down the new class names.

| CLASS NAMES |
|---|

3. Now mix all the pictures and re-classify them, trying not to use any of the class names you used in Steps 1 and 2. Write down your new class names. (Making a few classes is probably easier than forming many of them.)

| CLASS NAMES |
|---|

FOLLOW-UP TO ACTIVITY 2: (Read after doing Activity 2)

Doing this task on my own, I came up with the following. We'll use it as an example.

STEP 4:

| | Class names | Pictures in group |
|---|---|---|
| 1. | pens | fountain pen |
| | | ball point |
| 2. | women | black/white photo, (full figure) |
| | | color photo, (waist shot) |
| 3. | apparel | shoes |
| | | purse |
| 4. | cars | Chevy |
| | | Cadillac |
| | | Jaguar |
| | | VW |
| 5. | visual media | slide projector |
| | | TV |
| 6. | musical entertainment | piano |
| | | record player |
| 7. | clock | clock |
| 8. | cigarette lighter | cigarette lighter |
| 9. | wine bottle | wine bottle |
| 10. | words | pioneer |
| | | town |
| 11. | potted plant | potted plant |
| 12. | vessels | cups |
| | | pottery bowl |

There are two relevant points to what I did in Step 4.

1. Some of my classes had only one picture in them because I couldn't find another class to put the picture in, even though I know that everything is similar to something else in at least one way.
2. Most of my classes contained the fewest number of things that were maximally similar to each other. For example, the smallest group I could figure out for the piano and record player was "musical entertainment." I could have put them in a larger group, such as the class of things made by people, but that would have resulted in one large class. Musical entertainment was the smallest class I could put them in. Another way of looking at it is that I formed as many different classes as I could.

STEP 5:

Here's what I did at Step 5:

| Class names | |
|---|---|
| 1. machines | (I combined groups 1,4,5,6,7,8, from Step 4.) |
| 2. containers | (I combined groups 9,11,12, from Step 4.) |
| 3. words | Same as in Step 4 |
| 4. apparel | (I combined groups 2 and 3, because both women are wearing clothes.) |

Two points are of interest:

1. I was able to maintain the intension of all the previous classes and yet, at the same time, combine them to reduce the 12 groups to four. For example, all pianos, pens, etc., are machines.
2. The extension of the classes is now larger; that is, they include more things and, at the same time, things in my new classes are

less similar than those at Step 3. I could make them even less similar by saying, for example, that all 22 pictures are the same because they are "pictures" or everything is either "animal," "vegetable," or "mineral."

STEP 6:

For my third grouping, I came up with two classes that have more extension than my previous classes.

Class names

1. Black and White photos
2. Color photos

Two points of interest:

1. I know that all the things in these two classes belong, at the same time, to the earlier classes.
2. I also know that all of my earlier classes could have been divided into "black/white" and "color" classes.

**Activity 3: Sorting Pictures — Children**

In this activity you will do something with a child that is similar to what you did in Activity 2. It might be helpful to read some general notes on interviewing children before you work with children. These are on pages 49-52.

MATERIALS:

A magazine, scissors, a child between four and eight years of age.

INSTRUCTIONS FOR ACTIVITY 3:

1. Your first task will be to find a child with whom you can carry out Activity 3. The child should be between four and eight years of age, and ideally should be familiar with you and used to working with you. If not, pay particular attention to putting the child at ease.
2. To begin the task, you'll need to select some pictures to sort. You can use the pictures in Appendix C, or help the child cut out some from magazines. If you use the magazine, the activity will be more fun for you both. And because each child selects different pictures, it also assures the child that you can't compare with others their sorting of the same pictures.

   If you choose to use a magazine, have the child cut out pictures of things that they want to use in a "sorting activity." If the child's age makes it too time consuming to have him/her cut pictures out, then have him/her select them and you cut them out. Make up a collection of between 12-15 pictures. While cutting out shapes, have the child tell you what it is that s/he is cutting out. "What is it? What do you call it?" and so on.
3. Use Activity Form B for completing the activity.
4. Ask the child to put together pictures of things that are alike in some way.
   - Let the child know that s/he can do it any way s/he wants. Give assurances that s/he is doing what you asked.
   - If a child forms graphic collections (i.e., putting things together because they make up a whole, for example, putting

a purse with a woman because women carry them, or a person with a car because people drive them), ask him/her how all the things in the group are the same. DO NOT TELL THE CHILD THAT THINGS ARE NOT THE SAME IF S/HE SAYS THEY ARE.

- Let the child work at his/her own pace. Occasionally ask, "Is everything in the right group now?"

5. When the child is satisfied with his/her effort, ask what to call various groups. "What can we call all of these?" -- pointing to a group.

   Make a listing of the things the child puts together in the various groups.

6. If the child is still interested in the activity, you can ask the child to put some of his/her groups together. Say, "Put some of your groups with each other so that things that are alike are together." Children below the age of five will find your request confusing. If they don't get the idea, you should make your request easier to understand. For example, you might point to a group and ask if it is all right to put it with another group.

   If the child is still confused, stop. But leave the child with the sense that s/he accomplished what s/he was asked to do.

   If the child does combine groups, record which groups were combined.

ACTIVITY FORM B: Sorting Pictures - Child

Name: _____ Child's name: _____

Child's teacher: _____ Child's age: _____

Date: _____

To be used with Activity 3, page 27.

(Check One)

Did the child select the pictures, ☐ or did you select pictures for the child ☐ ?

| DO(CONDITIONS) | SAY |
|---|---|
| Put out the 15 or so pictures. | I WANT YOU TO PUT TOGETHER PICTURES THAT ARE THE SAME IN SOME WAY. |
| Record the groups. | |
| Record which group you asked about and what the child said. | WHAT DO YOU CALL ALL OF THESE? (Pointing to <u>one</u> of the child's groups) |

WHY DID YOU PUT THESE PICTURES TOGETHER?

If child is able to form classes and is still interested

PUT SOME OF THESE GROUPS TOGETHER TO MAKE LESS GROUPS, SO THAT THERE ARE NOT AS MANY PILES.

Record what child does.

FOLLOW-UP TO ACTIVITY 3:

The best follow-up to this activity with children is for you to discuss with other adults what you did and observed.

The following provide some focal points for your discussion:

1. Recall what you did, asked the child to do, and what the child did.
2. In what ways did the interview go well?
3. In what ways did it not go well?
4. If there were problems or misunderstandings, how could you make the interview better if you did it again?
5. How was the child's performance similar to or different from how you would solve the problem?
6. How do you think a younger or older child might deal with the task?

# CHAPTER 2

## WORKING WITH CHILDREN

This chapter is more "doing" oriented than the introductory chapter. As you work through Chapter 2, you will learn to administer three types of classification tasks and to record the child's responses in a way that will help you assess his/her stage of classification and intellectual development.

### INTERVIEWING A PARTNER

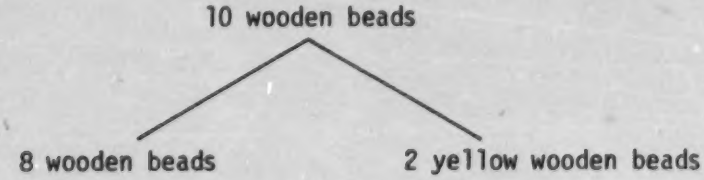
The three tasks are: inclusion problems, free, and structured sorting.

**Activity 4: Class Inclusion Problems (beads) — Adults**

You will start by administering these tasks to your partner. Then you will take the role of child and complete the tasks for your partner.

MATERIALS:

You will need 10 beads of two colors that can be strung on a string. You should have two of one color and eight of another. All the beads should be made of the same material, preferably wood. For example,




You will also need a string onto which the beads can be easily strung.

INSTRUCTIONS FOR ACTIVITY 4:

1. Use Activity Form C to determine what questions to ask. Make sure you read it thoroughly and understand it before you begin. Keep in mind that you will be comparing wooden beads and red beads; not red beads and yellow beads.
2. Record the responses of your partner in the appropriate spaces.
3. Switch roles and have your partner interview you. You can play the role of a child if you choose.

ACTIVITY FORM C: Inclusion Problems

Your name: _____ Child's name: _____

Date: _____ Child's age: _____

Child's Teacher: _____

This form is to be used to complete Activities 4 and 8 (pages 35 & 57).

| DO (CONDITIONS) | SAY |
|---|---|
| Present the beads all on a necklace. | WHAT ARE THESE? WHAT DO YOU CALL THEM? |
| | _____ |
| | WHAT ARE THEY MADE OF? |
| | _____ |
| | ARE THEY ALL MADE OF WOOD? |
| | _____ |
| Have child take necklace apart. | HOW MANY WOODEN BEADS ARE THERE? |
| | _____ |
| | HOW MANY RED ONES? |
| | _____ |
| | ARE THE RED ONES ALSO MADE OF WOOD? |
| | _____ |
| | HOW ABOUT THE YELLOW ONES? ARE THEY ALSO MADE OF WOOD? |
| | _____ |
| | *ARE THERE MORE WOODEN BEADS OR MORE RED ONES? (Refer last to the largest collection of single color beads.) WHY? |
| | _____ |

| | |
|---|---|
| If child says there are more (red) than (wooden) | I KNOW THERE ARE MORE RED THAN YELLOW, BUT ARE THERE MORE WOODEN OR MORE RED BEADS?<br><br>_____ WHY? _____<br><br>_____ |
| If you think child is not sure why there are logically more wooden than red beads, continue | IF I TAKE ALL THE YELLOW BEADS AWAY, WHAT WILL BE LEFT?<br><br>_____<br><br>WHAT WILL BE LEFT IF I TAKE ALL THE WOODEN BEADS AWAY?<br><br>_____<br><br>*ARE THERE MORE WOODEN OR MORE RED BEADS?<br><br>_____<br><br>WHY? _____<br><br>_____ |
| If child says there are more red... | MAKE A NECKLACE OUT OF THE WOODEN BEADS. |
| If child does not put all the beads on the string | WOULD IT BE ALRIGHT TO PUT THESE (pointing to excluded beads) ON THE NECKLACE?<br><br>_____ WHY? OR WHY NOT? ___<br><br>_____ |
| Take beads off the necklace | *IF I MAKE A NECKLACE OUT OF WOODEN BEADS AND YOU MADE ONE OUT OF THE RED BEADS, WHO WOULD HAVE THE LONGER NECKLACE?<br><br>_____<br><br>_____ |

* Class Inclusion Questions - we have used wooden beads as an example, but, of course, these sort of questions can be asked substituting many other kinds of materials.

**Activity 5: Free Sorting (attribute shapes) — Adults**

In this task you will administer a free sorting task to your partner. Afterwards, You'll switch roles.

MATERIALS:

Attribute blocks (See Appendix A).

3 colors (red, blue, yellow)

2 sizes

5 shapes (triangles, circles, squares, rectangles, hexagons) colored letters - mixed assortment with at least three of the attribute block colors. There should be duplicates of some letters, but not all.

INSTRUCTIONS FOR ACTIVITY 5:

1. Use Activity Form D
2. Record your partner's responses
3. Switch roles.

ACTIVITY FORM D: Free Sorting (Attribute Blocks)

Your name: _____ Child's name: _____

Date: _____ Child's age: _____

Child's Teacher: _____

To be used for Activities 5 and 9 (pages 39 & 63).

| DO (CONDITIONS) | SAY |
|---|---|
| Put out all the shapes and letters in a mixed order. | WHAT DO I HAVE HERE? |
| | _____ |
| | THAT'S RIGHT (shapes and letters). I'D LIKE YOU TO PUT TOGETHER THINGS THAT ARE ALIKE. |
| If child asks about the number of piles | YOU CAN MAKE AS MANY OR AS FEW AS YOU LIKE. BUT MAKE SURE THAT ALL THE THINGS YOU PUT TOGETHER ARE ALIKE OR SIMILAR IN SOME WAY. |
| Record what child does. | |

Select a group; preferably one in which the members are not all alike.

WHY DO THESE BELONG TOGETHER?

_____

_____

_____

(Describe the contents of the group you ask about.)

HOW ARE THEY ALL ALIKE?

_____

_____

_____

IF CHILD IS ABLE TO FORM COLLECTIONS OR GROUPS OF SIMILAR THINGS, GO ON TO ACTIVITY 6 -- FORM E: STRUCTURED SORTING.

**Activity 6: Structured Sorting (attribute shapes) — Adults**

This activity is an extension of Activity 5. The purpose is to acquaint you with how people coordinate "all and some" with similarities and differences when they are asked to combine groups.

MATERIALS:

Same as in Activity 5, plus three pieces of plain paper.

INSTRUCTIONS FOR ACTIVITY 6:

Same as Activity 5. Use Activity Form E.

ACTIVITY FORM E: Structured Sorting (Attribute Blocks)

Your name: _____ Child's name: _____

Date: _____ Child's age: _____

Child's Teacher: _____

This form is to be used to complete Activities 6 and 9 (pages 43 & 63).

| DO (CONDITIONS) | SAY |
|---|---|
| If in Activity 5 the child formed a large number of groups, have him/her combine them. | PUT SOME OF YOUR GROUPS TOGETHER. PUT THE GROUPS THAT ARE THE SAME IN SOME WAY TOGETHER. |
| or | or |
| (If the child formed only a few groups in Activity 5 have him/her break them into smaller groups.) | (I WANT YOU TO MAKE MORE GROUPS, SMALLER GROUPS. TAKE THESE GROUPS APART AND MAKE A LOT OF SMALL GROUPS OF THINGS THAT ARE THE SAME IN SOME WAY.) |
| Record what child does. | |
| When child is finished. | HOW ARE THEY ALL ALIKE? |
| | _____ |
| | _____ |

| | |
|---|---|
| Mess up all the shapes and letters. Put out three pieces of paper. | I WANT YOU TO MAKE THREE DIFFERENT GROUPS OF THINGS - GROUPS YOU HAVEN'T MADE YET.<br>(If child already formed three groups, recall what they were and ask for a new, different classification.) |
| Record the three groups. | YOU CAN PUT YOUR GROUPS ON THESE PIECES OF PAPER IF YOU WANT TO. |
| If child easily does this, ask for another way. | TRY TO THINK OF EVEN ANOTHER WAY YOU COULD FORM THREE GROUPS. |
| Record the new groups. | |

## WATCHING A VIDEOTAPE

In this section of Chapter 2, you will view a videotape showing children four to eight years of age being interviewed on the same tasks you did in Activities 4 - 6.

This tape was made at the Hillside Primary School in Berkeley, California, with the cooperation of the school, teachers, children and their parents. The children were selected by their teacher, primarily on the basis of their ability to cope with the tremendous confusion of a video production and the stress of being filmed.

The youngest children were interviewed by their teacher, Daniel Peletz. The six, seven and eight year olds were interviewed by someone they had just met. There was no rehearsing and no retakes. Despite the presence of strangers, the physical discomfort and chaos, and the general unfamiliarity of the situation, the children were able to concentrate on the tasks, were seriously involved, interested and, on the whole, enjoyed themselves. This illustrates the mental power that children of any age bring to bear on activities that tap their intellect and reasoning. While the raw footage was edited for clarity and the restrictions of a 30 minute show, what you see is an honest and accurate portrayal of children actively reasoning about classes.

**Activity 7: Viewing the Videotape — The Development of Classification.**

INSTRUCTIONS FOR ACTIVITY 7:

1. Review the following outline of the tape:

| Child | Age | Stage | Problem |
|---|---|---|---|
| Ian | 4 | Pre-conceptual | Beads |
| Ryan | 8 | Concrete-operational | Beads |
| Darrilyn | 4 | Pre-conceptual | Beads |
| Ian | 4 | Pre-conceptual | Free sorting |
| Darrilyn | 4 | Pre-conceptual | Free sorting |
| Miles | 6 | Intuitive | Free sorting<br>Structured sorting |
| Ryan | 8 | Concrete-operational | Free sorting<br>Structured sorting |
| SUMMARY | | | |

2. Look for how Ian, Darrilyn, and Miles handle the tasks differently than adults. Look for similarities as well.
3. Look for how Ryan's performance is similar to that of adults, as well as different.

   (You can use the transcript of the tape - Appendix B - to make notes on the film.)

## INTERVIEWING CHILDREN

In this section of Chapter 2, we'll discuss a number of issues that will help you prepare to interview children on the tasks you saw in the videotape.

### Do's and Don'ts of Interviewing

1. It is important that you enter the interview with the right attitude. This should be a curiosity about how children classify, and a willingness to explore ways of finding out. Do not be concerned with whether or not children have the "right" answers. There are no "wrong" answers to these types of tasks. If given the opportunity, children will do as well as they can, and the object is to gain more insight into how children reason by seeing how they think about class relations.

   A typical mistake of beginning interviewers is to try to get the best, most advanced response from the child. This is understandable, but it inevitably results in hounding the child, making instructions too complex, and generally communicating to the child that you want something s/he is not giving you, that there is something wrong with his/her thinking. It's better to go slow and let the child take the lead with as little interference from you as possible. The child's reasoning is sensitive and personal and you should maintain a respect for it throughout the interview.

2. Present the classification materials to the child in a natural manner, saying something like, "Let's work with these for a while," or "I have some things I want you to do with these." The tasks will generally strike children as natural and reasonable. In one form or another, children naturally engage in classification from birth on. Rather than providing a lot of explanations, just get going.

3. Remain as flexible as possible throughout the interview. If the child does not immediately respond to your questions, wait and ask again. If the child does not do what you ask, let him/her fool around a bit. The child may need some time to feel comfortable with the materials. If the child comments on things, even if they do not relate to the task, listen and respond to what is said. When you feel that the child is drifting from the focus, remind him/her of what you want. The experience itself should be pleasurable for you and the child. If you feel uncomfortable, or the child is feeling anxious and uncomfortable, then it is best to discontinue the interview. If the child gives any indication of wanting to quit, respect this need.

4. Try not to be anxious with yourself or the child. You can and will make "mistakes," fail to ask the "right" questions, misunderstand the child,and so on. It takes experience to become a good interviewer. You will have to make mistakes to learn. So don't worry about it. If you worry, you'll probably worry the child as well. Children like to share their thoughts with adults if adults seem interested and respectful.

5. Remember, you are the adult, it's your interview and you're in control. Be clear to the child about what you want. If you let the child "take over," s/he will do whatever strikes his/her fancy and you will have learned little. For example, if the child starts using a block as a toy car, driving it around the table, you can say, "You can play cars after we've finished, but now I want you to..." If the child persists, end the interview. You can always return to it when condi[illegible] are better.

6. The language you use is important.

   - When asking a child to sort, say: "I want you to put together ones that are alike, that are the same in some way." If you say "Put together things that belong together or go together," the child is more likely to misunderstand and form graphic collections.
   - When you want a child to do something, state what you want, e.g., "Put your piles more together," If you say "could you..." or "would you..." it is less clear to the child what you want.
   - Be as simple and concrete in your language as you can. It's hard for the child to understand complex insturctions. For example, "Put your groups more together," may actually communicate more directly than the logical expression, "Make less p[illegible]les." You might ask a child to "Combine your groups so that there are only some groups."
   - Do not solve the task for the child by telling him/her how or on what basis you want them to sort. For example, don't say, "Put all the same color shapes together" or (holding up an

object) "What is this? Can you find more of these and put them together?" You're interested in the properties that the child uses to sort and how s/he uses them, so don't determine these issues for the child.

7. When objects still remain after the child has presumably finished sorting, guide him/her to sort further with questions such as, "Is everything where it belongs?" "How about these?" pointing to the remaining group. "Are these supposed to stay by themselves?" If the child answers, "Yes," then ask something like, "Would it be all right to put them with these?" (indicating an appropriate group). If the child says "They should not stay by themselves," ask "Then what will you do with them?" "Where will you put them?" "Where do they fit in best?"

The Form of the Interview

A good interview is not the result of following a prescribed procedure word for word,or being good at following a set of instructions. A good interview results from being attentive to what the child is doing, how s/he is understanding your instructions, and from forming "educated guesses" about why the child is doing one thing or another. Your development as an interviewer depends upon your concern for exploring the child's thinking, your clarity about what you are looking for, and your ability to invent questions "on the spot" that help you get a clear picture of the child's thinking. This skill takes time and practice.

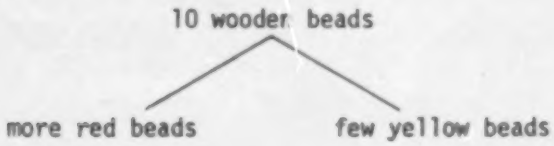
1. Class inclusion task

The ideal procedures for this task are presented on Form C. Use this form while you are interviewing the child. For your first few interviews you should follow it as closely as possible. After some practice, you can work without it.

The general character of the procedure is this:

a. Make sure the child knows how all the objects are the same (wooden) and how they are different (red and yellow).

b. Ask the inclusion question, e.g., "Are there more wooden beads or more red beads?"




There are a number of points about this question. First, it asks for a comparison between the total group (wooden) and the largest subgroup (red). When phrasing the question, the name of the total group (wooden) comes first. This is because when children are unsure, they often give the last choice in your question as their answer.

c. If the child answers correctly, explore the child's reasoning. "Why is that the case?"

d. If the child fails to express an understanding of the class relations, then continue to see if the child knows that if the red beads are taken away, the yellow ones will be left; if the yellow ones are taken, the reds will

remain; and if the wooden beads are taken, nothing will remain.

e. If the child can answer these questions correctly, then ask the inclusion question again.

2. Sorting tasks

The ideal procedure for sorting tasks is presented on FORMS D and E. If the child handles "free sorting" reasonably well, you can go on to "structured sorting."

Try to follow the outline as presented on FORMS D and E. However, keep in mind that on these tasks particularly, the child is liable to exert his/her own will and you will have to be able to modify your approach. The main points to explore are these:

a. See how the child handles similarities and differences among the properties when asked to sort the objects into classes (groups).

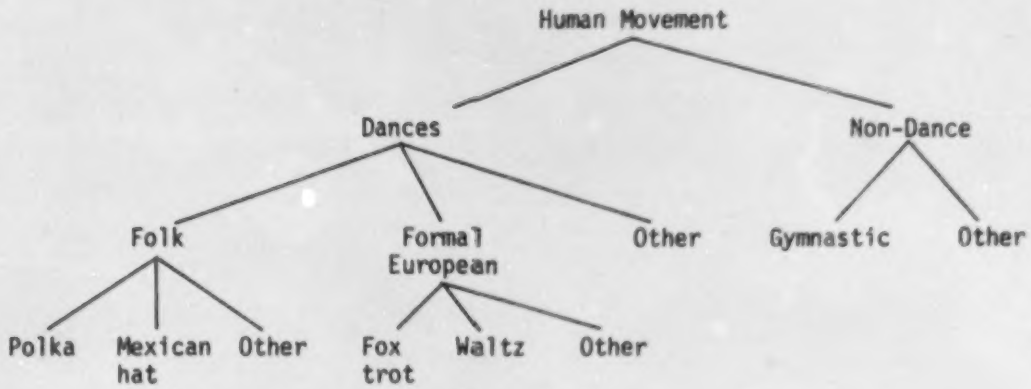
b. See if the child understands that the same objects have many common properties upon which they can be sorted. This is what is being explored when you ask children to combine groups, break groups into subgroups, and sort the same objects in a number of different ways.

Additional Ways of Finding Out

1. Class inclusion task

In general, any task that gets at the child's reasoning about two classes that are similar and at the same time different from each other is getting at the child's understanding of class inclusion relations. Asking about which class has more members in it, the class to which both belong, or the largest of the two subclasses

is one way of assessing the child's understanding. This type of problem can be created for a countless range of issues and materials, e.g., "more cars or more two-door cars?" "more flowers or more roses?" "more animals or more farm animals?" and so on. It should be kept in mind that the issue of class inclusion is involved in all hierarchical classifications, i.e., all classifications where some classes are contained in other classes. For example, the following tree diagram is of a hierarchical classification in which there are a number of inclusion relations.




2. Sorting tasks

The following are some additional ways that you can explore the child's classification:

a. You can start a classification and have the child complete it. For example, put a red square and a red triangle in one pile and a yellow circle and a yellow triangle in another. Say something like "I'm going to put these together. You put on some more things that are like all the things in my pile."

b. If you're unsure why the child has put some things together, you can introduce a new shape (or object) that you think will belong or not belong in some of the child's groups. "Here's a new shape (object, etc.). Put this one where it belongs." For example, a child may have a group of red objects and a group of circles, some of which are red. You might introduce another red circle to see where the child puts it.

Increasing and Decreasing the Task Difficulty

The purpose is not to make the task "easy" so that the child gets the "right" answer, but rather, to keep the task at a level where the child feels comfortable dealing with it. Experience will be your best guide to what children of various ages can handle.

As a rough guide, consider that the sorting tasks (as presented in FORMS D and E) are roughly sequential. That is, there are a number of steps. If the child is doing all right with Step 1, then move on to Step 2 and so forth. If the child is having difficulty, don't move on to more difficult questions.

In the sorting tasks, you can simplify things by using a less complex set and/or a smaller number of materials to be sorted. For example, eliminating simplifies the problem. Likewise, you can reduce the number of shapes (e.g., eliminating all the "thin" shapes.) You can increase the difficulty by increasing the number of objects to be classified, and/or by increasing the number of properties on which the objects can be classed, and/or by adding very different things that are also similar, such as colored letters and shapes.

**Activity 8: Class Inclusion Tasks with Children**

In this activity you will interview two children between the ages of four and eight on a class inclusion task. You should use FORM C as a guide. The purpose of the activity is to assess children's class reasoning. After the interview you will share with adults what you did and what the child did.

MATERIALS:

10 wooden beads (eight of one color and two of another); string on which the beads can be easily strung

INSTRUCTIONS FOR ACTIVITY 8:

1. Follow the instructions on FORM C.
2. Record any additional information that will help you share with others what you did and what the child did. Pay attention to ways in which you felt the interview went well and not so well.

ACTIVITY FORM C: Inclusion Problems

Your name: _____ Child's name: _____

Date: _____ Child's age: _____

Child's Teacher: _____

This form is to be used to complete Activities 4 and 8 (pages 35 & 57).

| DO (CONDITIONS) | SAY |
|---|---|
| Present the beads all on a necklace. | WHAT ARE THESE? WHAT DO YOU CALL THEM? _____ |
| | WHAT ARE THEY MADE OF? _____ |
| | ARE THEY ALL MADE OF WOOD? _____ |
| Have child take necklace apart. | HOW MANY WOODEN BEADS ARE THERE? _____ |
| | HOW MANY RED ONES? _____ |
| | ARE THE RED ONES ALSO MADE OF WOOD? _____ |
| | HOW ABOUT THE YELLOW ONES? ARE THEY ALSO MADE OF WOOD? _____ |
| | *ARE THERE MORE WOODEN BEADS OR MORE RED ONES? (Refer last to the largest collection of single color beads.) WHY? _____ |

| | |
|---|---|
| If child says there are more (red) than (wooden) | I KNOW THERE ARE MORE RED THAN YELLOW, BUT ARE THERE MORE WOODEN OR MORE RED BEADS?<br><br>_____ WHY? _____<br><br>_____ |
| If you think child is not sure why there are logically more wooden than red beads, continue | IF I TAKE ALL THE YELLOW BEADS AWAY, WHAT WILL BE LEFT?<br><br>_____<br><br>WHAT WILL BE LEFT IF I TAKE ALL THE WOODEN BEADS AWAY?<br><br>_____<br><br>ARE THERE MORE WOODEN OR MORE RED ?<br><br>_____<br><br>WHY? _____<br><br>_____ |
| If child says there are more red... | MAKE A NECKLACE OUT OF THE WOODEN BEADS. |
| If child does not put all the beads on the string | WOULD IT BE ALRIGHT TO PUT THESE (pointing to excluded beads) ON THE NECKLACE?<br><br>_____ WHY? OR WHY NOT? ___<br><br>_____ |
| Take beads off the necklace | *IF I MAKE A NECKLACE OUT OF WOODEN BEADS AND YOU MADE ONE OUT OF THE RED BEADS, WHO WOULD HAVE THE LONGER NECKLACE?<br><br>_____<br><br>_____ |

* Class Inclusion Questions - we have used wooden beads as an example, but, of course, these sort of questions can be asked substituting many other kinds of materials.

ACTIVITY FORM C: Inclusion Problems

Your name: _____ Child's name: _____

Date: _____ Child's age: _____

Child's Teacher: _____

This form is to be used to complete Activities 4 and 8 (pages 35 & 57).

| DO (CONDITIONS) | SAY |
|---|---|
| Present the beads all on a necklace. | WHAT ARE THESE? WHAT DO YOU CALL THEM? |
| | WHAT ARE THEY MADE OF? |
| | ARE THEY ALL MADE OF WOOD? |
| Have child take necklace apart. | HOW MANY WOODEN BEADS ARE THERE? |
| | HOW MANY RED ONES? |
| | ARE THE RED ONES ALSO MADE OF WOOD? |
| | HOW ABOUT THE YELLOW ONES? ARE THEY ALSO MADE OF WOOD? |
| | *ARE THERE MORE WOODEN BEADS OR MORE RED ONES? (Refer last to the largest collection of single color beads.) WHY? |

| | |
|---|---|
| If child says there are more (red) than (wooden) | I KNOW THERE ARE MORE RED THAN YELLOW, BUT ARE THERE MORE WOODEN OR MORE RED BEADS?<br><br>_____ WHY? _____<br><br>_____ |
| If you think child is not sure why there are logically more wooden than red beads, continue | IF I TAKE ALL THE YELLOW BEADS AWAY, WHAT WILL BE LEFT?<br><br>_____<br><br>WHAT WILL BE LEFT IF I TAKE ALL THE WOODEN BEADS AWAY?<br><br>_____<br><br>*ARE THERE MORE WOODEN OR MORE RED BEADS?<br><br>_____<br><br>WHY? _____<br><br>_____ |
| If child says there are more red... | MAKE A NECKLACE OUT OF THE WOODEN BEADS. |
| If child does not put all the beads on the string | WOULD IT BE ALRIGHT TO PUT THESE (pointing to excluded beads) ON THE NECKLACE?<br><br>_____ WHY? OR WHY NOT? ___<br><br>_____ |
| Take beads off the necklace | *IF I MAKE A NECKLACE OUT OF WOODEN BEADS AND YOU MADE ONE OUT OF THE RED BEADS, WHO WOULD HAVE THE LONGER NECKLACE?<br><br>_____<br><br>_____ |

* Class Inclusion Questions - we have used wooden beads as an example, but, of course, these sort of questions can be asked substituting many other kinds of materials.

**Activity 9: Sorting Tasks with Children**

In this activity you will interview two children between four and eight years of age on a sorting task. If possible, they should be the same children you interviewed in Activity 8.

MATERIALS:

Attribute blocks (see Appendix A)

3 colors (red, blue, yellow)

2 thicknesses

5 shapes (triangles, circles, squares, rectangles, hexagons) Colored letters - mixed assortment with at least three of the attribute block colors. There should be duplicates of some letters, but not all. Simplify the materials for four and five year olds.

INSTRUCTIONS FOR ACTIVITY 9:

1. Follow the procedures on FORMS D and E. Do those on FORM D first. If the child is able to form classes of similar things, go on to FORM E.
2. Keep an accurate record of the actual materials used, what you did (said) and what the child did (said). Draw or describe the actual groups formed by the child.

ACTIVITY FORM D: Free Sorting (Attribute Blocks)

Your name: _____ Child's name: _____

Date: _____ Child's age: _____

Child's Teacher: _____

To be used for Activities 5 and 9 (pages 39 & 63).

| DO (CONDITIONS) | SAY |
| --- | --- |
| Put out all the shapes and letters in a mixed order. | WHAT DO I HAVE HERE? |
| | _____ |
| | THAT'S RIGHT (shapes and letters). I'D LIKE YOU TO PUT TOGETHER THINGS THAT ARE ALIKE. |
| If child asks about the number of piles | YOU CAN MAKE AS MANY OR AS FEW AS YOU LIKE. BUT MAKE SURE THAT ALL THE THINGS YOU PUT TOGETHER ARE ALIKE OR SIMILAR IN SOME WAY. |
| Record what child does. | |

Select a group; preferably one in which the members are not all alike.

WHY DO THESE BELONG TOGETHER?

_____

_____

_____

(Describe the contents of the group you ask about.)

HOW ARE THEY ALL ALIKE?

_____

_____

_____

IF CHILD IS ABLE TO FORM COLLECTIONS OR GROUPS OF SIMILAR THINGS, GO ON TO ACTIVITY 6 -- FORM E: STRUCTURED SORTING.

ACTIVITY FORM D: Free Sorting (Attribute Blocks)

Your name: _____ Child's name: _____

Date: _____ Child's age: _____

Child's Teacher: _____

To be used for Activities 5 and 9 (pages 39 & 63).

| DO (CONDITIONS) | SAY |
|---|---|
| Put out all the shapes and letters in a mixed order. | WHAT DO I HAVE HERE? |
| | _____ |
| | THAT'S RIGHT (shapes and letters). I'D LIKE YOU TO PUT TOGETHER THINGS THAT ARE ALIKE. |
| If child asks about the number of piles | YOU CAN MAKE AS MANY OR AS FEW AS YOU LIKE. BUT MAKE SURE THAT ALL THE THINGS YOU PUT TOGETHER ARE ALIKE OR SIMILAR IN SOME WAY. |
| Record what child does. | |

Select a group; preferably one in which the members are not all alike.

WHY DO THESE BELONG TOGETHER?

_____

_____

_____

(Describe the contents of the group you ask about.)

HOW ARE THEY ALL ALIKE?

_____

_____

_____

IF CHILD IS ABLE TO FORM COLLECTIONS OR GROUPS OF SIMILAR THINGS, GO ON TO ACTIVITY 6 -- FORM E: STRUCTURED SORTING.

ACTIVITY FORM E: Structured Sorting (Attribute Blocks)

Your name: _____ Child's name: _____

Date: _____ Child's age: _____

Child's Teacher: _____

This form is to be used to complete Activities 6 and 9 (pages 43 & 63).

| DO (CONDITIONS) | SAY |
| --- | --- |
| If in Activity 5 the child formed a large number of groups, have him/her combine them. | PUT SOME OF YOUR GROUPS TOGETHER. PUT THE GROUPS THAT ARE THE SAME IN SOME WAY TOGETHER. |
| or | or |
| (If the child formed only a few groups in Activity 5 have him/her break them into smaller groups.) | (I WANT YOU TO MAKE MORE GROUPS, SMALLER GROUPS. TAKE THESE GROUPS APART AND MAKE A LOT OF SMALL GROUPS OF THINGS THAT ARE THE SAME IN SOME WAY.) |
| Record what child does. | |
| When child is finished. | HOW ARE THEY ALL ALIKE? |
| | _____ |
| | _____ |

| | |
|---|---|
| Mess up all the shapes and letters. Put out three pieces of paper. | I WANT YOU TO MAKE THREE DIFFERENT GROUPS OF THINGS - GROUPS YOU HAVEN'T MADE YET.<br>(If child already formed three groups, recall what they were and ask for a new, different classification.) |
| Record the three groups. | YOU CAN PUT YOUR GROUPS ON THESE PIECES OF PAPER IF YOU WANT TO. |
| If child easily does this, ask for another way. | TRY TO THINK OF EVEN ANOTHER WAY YOU COULD FORM THREE GROUPS. |
| Record the new groups. | |

ACTIVITY FORM E: Structured Sorting (Attribute Blocks)

Your name: _____ Child's name: _____

Date: _____ Child's age: _____

Child's Teacher: _____

This form is to be used to complete Activities 6 and 9 (pages 43 & 63).

| DO (CONDITIONS) | SAY |
|---|---|
| If in Activity 5 the child formed a large number of groups, have him/her combine them. | PUT SOME OF YOUR GROUPS TOGETHER. PUT THE GROUPS THAT ARE THE SAME IN SOME WAY TOGETHER. |
| or | or |
| (If the child formed only a few groups in Activity 5 have him/her break them into smaller groups.) | (I WANT YOU TO MAKE MORE GROUPS, SMALLER GROUPS. TAKE THESE GROUPS APART AND MAKE A LOT OF SMALL GROUPS OF THINGS THAT ARE THE SAME IN SOME WAY.) |
| Record what child does. | |
| When child is finished. | HOW ARE THEY ALL ALIKE? |

_____

_____

| | |
|---|---|
| Mess up all the shapes and letters. Put out three pieces of paper. | I WANT YOU TO MAKE THREE DIFFERENT GROUPS OF THINGS - GROUPS YOU HAVEN'T MADE YET.<br>(If child already formed three groups, recall what they were and ask for a new, different classification.) |
| Record the three groups. | YOU CAN PUT YOUR GROUPS ON THESE PIECES OF PAPER IF YOU WANT TO. |
| If child easily does this, ask for another way. | TRY TO THINK OF EVEN ANOTHER WAY YOU COULD FORM THREE GROUPS. |
| Record the new groups. | |

FOLLOW-UP TO ACTIVITIES 8 and 9

The best follow-up to these activities with children is for you to discuss with other adults what you did and observed.

The following provides some focal points for your discussion:

1. Recall what you did, asked the child to do, and what the child did.
2. In what ways did the interview go well?
3. In what ways did it not go well?
4. If there were problems or misunderstandings, how could you make the interview better if you did it again?
5. How was the child's performance similar to or different from how you would solve the problem?
6. How do you think a younger or older child might deal with the task?

# CHAPTER 3

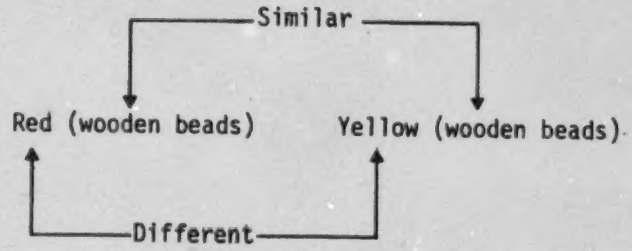
# ASSESSING STAGES OF CLASSIFICATION

## GENERAL REMARKS ON THE DEVELOPMENT OF CLASSIFICATION

If you saw a four year old child placing three blue triangles together, you might think, "That child is classifying in the same way I would." The child is classifying, but probably not in the same way an adult or, for that matter, a concrete-operational child would. The younger child classifies differently. To know the actual nature of a child's reasoning about similarities and differences requires more than observing that similar things are sometimes placed with each other. A child's handling of any one task may produce results that look like something they aren't. To explore a child's class reasoning requires understanding the nature of class structures during various stages of development and knowing how to administer tasks that tap the child's use of these structures.

As adults, we recognize that different objects may share similar properties and, at the same time, have properties on which they differ; young children do not understand this distinction. This is clarly revealed in a class inclusion problem. In terms of material, red and yellow wooden beads share the same property. In terms of color they don't. It logically follows that there are more wooden than red objects. One does not have to count the beads to know this. It is known with the same certainty that we know there are more children than girls, or more flowers than roses.

1.0
1.1
1.25
1.4
1.6
1.8
2.0
2.2
2.5
2.8
3.2
3.6
4.0
MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A




This kind of reasoning indicates an understanding of class relations, an ability to consistently coordinate the relationships among objects and their properties, and coordination of the concepts "all" and "some" (all of the red beads are only some of the wooden beads). The young child does not co-ordinate intension and extension in this way.

---

## THE PRE-CONCEPTUAL STAGE-- GRAPHIC COLLECTIONS (GENERALLY 2-5 YEARS OF AGE)

---

RE-READ PAGES 11 THROUGH 14.

It is hard for the beginner to see what is common to the classification of children in this period. We have already pointed out some of the main characteristics:

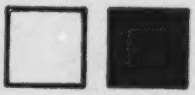
1. A class for the pre-conceptual child is always a visual whole.
2. Few of the classes formed by the child share similar properties.
3. When there are similar properties (a class intension), there usually are objects sharing that property that are not included in the class, and there are generally still concerns for arrangement.

Association plays an important role in the pre-conceptual child's collections. S/he will put together objects that look either similar or familiar together. The child may experiment or accidentally discover a pattern, construction or combination that appeals to him/her. S/he then

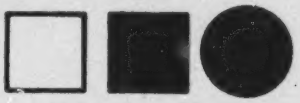
often repeats these patterns.

Resemblance Sorting and Matching

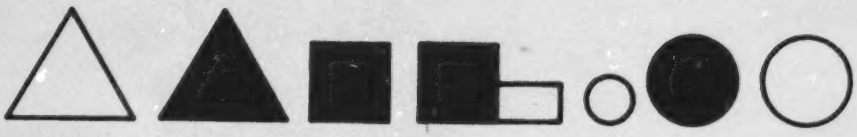
One of the commonest forms of early classification is simply the placing together of two things that match or resemble each other. The objects are usually placed in a straight line.



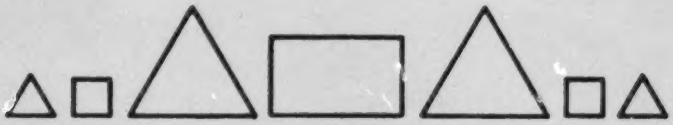
If the child is asked to put more things with one of the groups, s/he generally adds something that matches some properties of the existing group, but not necessarily the property shared by all the members of the group. The motivation is usually simple association of a property that some item outside the group shares with an element in the group. Again the arrangement is often linear.



When a number of objects become involved, the group is called a "linear arrangement."



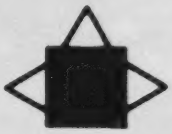
The child often attempts to organize the linear arrangement so that there is a symmetrical (balanced) pattern.



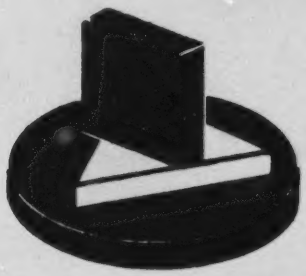
Often things are put together because the child can do the same thing with them. For example, the child may find that a triangle can be put on its edge. Being pleased with the result, the child may continue to place triangles on their edges in close proximity to each other, forming something that looks like a "tent village."

Complex Constructions

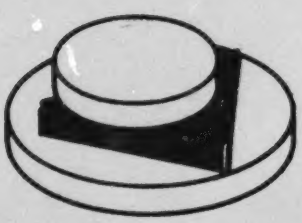
Children in this period will often do things such as the tent village; at other times they might form "objects" built out of the blocks. Some of these "objects" may simply be pleasing forms, usually with symmetry.

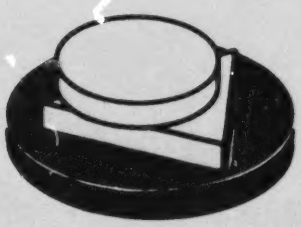


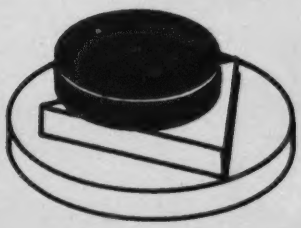
Some may be stacked constructions.



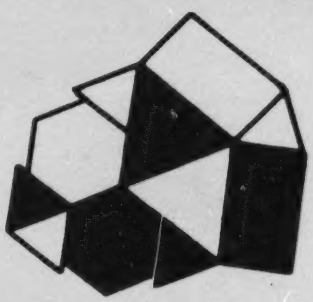
The pre-conceptual child often forms a number of similar looking piles as if s/he understood the instructions to be "Make piles that look the same."

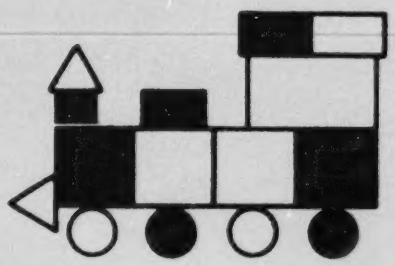






In other cases, the child may use a large number of objects to form one large picture.





So far we have talked about graphic collections using blocks which, by their very nature, call for constructions such as towers, patterns, etc. What happens when you use objects that are more representative of the world the child lives in?

If you interviewed a four or five year old in the picture sorting activity (Activity 3), you probably have already experienced the answer. And in the videotape you saw Miles using miniature representational objects (e.g., furniture, utensils, people, animals). Let's examine some of the additional characteristics of graphic reasoning.

At this stage, the associations among objects in the child's life become dominant. Six year old Miles, in the intuitive stage, is quite capable of handling similarities and differences. He showed this by forming a number of classes such as "people," "animals," "plates," "silverware," "glasses," "tables," "chairs," "cribs." But when asked to perform the more difficult task of combining groups, he put together the table, chairs, eating utensils, and the people to form a complex table scene. It was a natural solution to the problem suggested, no doubt, by the anticipation of an actual Thanksgiving dinner, on the following day. His table scene was a graphic collection. However, with a little probing, Miles showed that he could go beyond graphic collections. The table idea simply appealed to his "mind's eye."

Ryan, who is eight, also formed graphic collections in the form of words, putting together letters that are strongly associated with each other. However, Ryan was even more capable than Miles of switching focus and considering the similarities and differences within and among properties of objects.

The pre-conceptual child, on the other hand, puts together representational objects that find their associations in play, in the world, in fantasy, in desire, etc. No amount of questioning or probing will elicit a set of classes like the ones Miles and Ryan are able to form. The pre-conceptual child simply does not yet reason in this way.

The thing that is common to all of these graphic performances is the production of representational images. In some cases, it's a representation of patterns, symmetries, similar looking towers, etc. In other cases, it is a representation of the child's understandings about the world. Purses go with women; chairs, tables, people, silverware, etc., go together to make a Thanksgiving scene. Letters go together to make a word. It is the child's creation of representational images of visual wholes that justifies the use of the term "graphic" to describe the classifications of the pre-conceptual child.

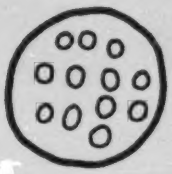
## How Do the Graphic Collections Relate to the Pre-Conceptual Child's Inability to Correctly Reason About Class Inclusion Problems?

To solve the inclusion problem, one must be able to "keep in mind" three separate classes and the relationships among these classes. The child must consider the red wooden beads, the wooden beads that are not red, and the wooden beads. By four or five, most children can consider these single classes.

They know:

That all the beads are wooden;

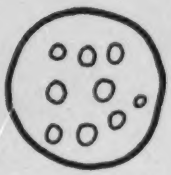
wooden



and that there are red wooden beads and yellow wooden beads.

yellow beads

red beads



What they don't know is that there are <u>necessarily</u> more wooden than red beads. The reason is that the pre-conceptual child cannot compare the class that is composed of the <u>red and yellow beads</u> (wooden ones) and at the same time, consider one of the subclasses (red) that participates in forming the class to which it and the other class belong.

The child's conception of the class "wooden beads" is still a visual picture, i.e., it is graphic. In the film, we called it a "spatial whole." When asked to consider a part of the picture, the child can no longer keep in mind the total picture and thus compares its parts to each other rather than a part to the whole. As we say in the film, the child's mental picture of the whole is broken into parts when asked to consider a part (red). As a result, the whole (wooden) no longer exists, and the child compares

the class of red to the class of yellow beads.

It is generally not until five years of age that children understand that all the red beads are wooden, that all the yellow beads are wooden, that the red are only some of the wooden beads, and that the yellow are only some of the wooden beads. Likewise, it is not until then that a child can reason that if all the red ones are removed the yellow will remain, that if all the wooden are removed, none will remain, and so forth. However, when these relations are first understood, they are not yet coordinated with one another. As a result, the child fails to recognize that there are necessarily less red than wooden beads, or that all the red beads are only some of the wooden beads.

In closing, we should share one last but important observation regarding the classifications of the pre-conceptual child. When asked to sort a variety of objects into groups sharing common properties, the pre-conceptual child seldom succeeds in classifying all the objects. Those objects that capture the child's attention and interest, those that are strongly associated with one another, are placed into groups. But the child of this stage is not thinking, "All of these in this group are going to be 'Xs'." Nor does the child reason, "All of these in this group are 'Xs'." If such reasoning were taking place, there would be some concern with finding all of the "Xs." However, since children of this stage are considering associations between one object and another rather than similarities and differences among properties of objects, we typically see a failure to classify all of the objects. In addition, and for the same reasons, the pre-conceptual child has difficulty constructing a variety of classes that are sufficient to incorporate all of the objects.

## THE INTUITIVE STAGE-- NON-GRAPHIC COLLECTIONS (GENERALLY 6-7 YEARS OF AGE).

RE-READ PAGES 14 THROUGH 17 OF CHAPTER ONE.

We've already pointed out some important characteristics of the intuitive child's classes. Of the following two, one reflects development from the pre-conceptual stage and the other indicates less complete class formation than that seen in the concrete-operational stage.

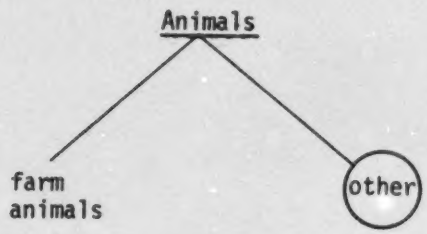
(+)1. The child puts together things that share common properties. That is, s/he forms classes with a class intension. The whole (class) is no longer tied to a graphic conception or "visual whole."

(-)2. The intuitive child fails to coordinate intension and extension. As, for example, when the child forms a class of things sharing some common property, but excludes other things even though they share the same property.

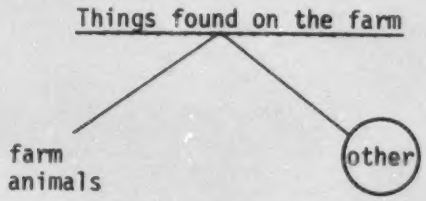
Piaget calls the classes of this stage "non-graphic collections." They are called "collections," rather than "classes," because "true classes" require an ability to coordinate relations of all and some with similarities and differences among properties of objects, which the intuitive child is not yet able to do. The intuitive child's classes, then, are no more than collections of things that are alike.

Let's examine why "true classes" require this coordination of class relations. If you form a collection of things that are similar in some way, then you also mentally imply a class of things that do not belong. This class is called the "complement class." It is impossible to have a group of things that one knows to be similar without knowing how, at the same time, all are in some way different from everything else that was considered in the sorting. For example, if you form a class of "farm animals" you automatically form a complementary class of things that are not farm animals. As the mind forms the complementary class, it raises the question, "What is in the complementary class? Is it all the things in the world that are not farm animals (e.g., clowns, chairs, socks, light bulbs, houses)?" In other words, what is the extension of this class?

The problem becomes one of defining the intension and corresponding extension of the complementary class, or defining what is the same about all the things that it includes. One solution, the one seen in the sorting of most concrete-operational children and adults, is to define the intension of the complement in terms of a larger class to which both belong. In terms of our example, we might define the intension of the complement as "animals not found on the farm" (e.g., lions and crocodiles),



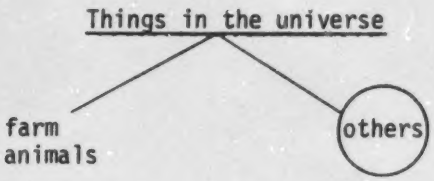
or, "things found on a farm that are not animals,"




or, "domestic animals that are not farm animals."

Of course, you could also come up with, "living things that are not farm animals,"

or even, "things in the universe that are not farm animals."



That is, in order to form a single class, you automatically raise problems that can only be decided by considering at least two other classes. During the pre-conceptual stage there is virtually no concern with the relation between a class and its complement and the higher order class that defines them both. By six years of age, on the other hand, children begin to consider the relation between classes. This is because by the intuitive stage children can form classes of things sharing a common property. However, the classes are not well coordinated and only gradually become so.

By the concrete-operational stage there are the first systematic and reversible coordinations. What is meant in this context by "reversible" is simply that the concrete-operational child knows both that one class added to another together make up a third class and that this relationship can be reversed. For example, the red and yellow beads add up to all the wooden beads (A + A' = B): the wooden beads that are not red add up to all the yellow beads (B - A = A'); the wooden beads that are not yellow are all the red beads (B - A' = A). This is essentially the same kind of reversible reasoning that allows us to know that if 5 + 3 = 8, then 8 - 5 = 3 and 8 - 3 = 5.

What, in essence, distinguishes the intuitive and pre-conceptual from the concrete-operational child is that the latter is capable of reasoning about classes while thinking reversibly about the properties of objects. For example, the beads that are red and yellow are wooden (R + Y = W) and the beads that are red are all the wooden ones that are not yellow (R=W-Y). This is an inevitable and crucial step in the development of classification. It is clear that with the construction of true classes, formed by a coordination of similarities and differences, comes a parallel understanding of the relation between a class and its complement and a class to which both

belong, a higher order class. Although further developments are revealed in the thinking of adolescents and adults, this form of reasoning, this coordination that enables flexible reversibility, is the basis of all future classifications.

In the film, we see some of the difficulty that arises when this coordination is lacking. Miles, who is six years of age, can put together objects that are similar. The fact that they are very similar is important. The glasses, plates, knives, spoons, chairs, cribs, etc., are all regarded as separate classes. The problem surfaces when Miles is asked to combine some of his groups. "How are some of these small groups similar to each other?" That is, what is the class to which at least two of the groups belong? To our adult mind, we can think of ways in which, for example, the table, chairs, and cribs could be put together in a higher order class, such as the class of "furniture." As you see, Miles does not do this, although he does understand the concept of furniture.

Unlike Ryan,who is in the concrete-operational stage, Miles lacks the mental flexibility that accompanies reversible operations. He has difficulty anticipating where his actions will lead him. When asked to divide the utensils, cribs, chairs, table into two classes (put them on two pieces of paper), he starts by placing similar items on each of the pieces of paper, as if saying "I've got part of the problem solved because I've got two cribs on one piece of paper and four chairs on the other." But this doesn't work too well, and it precludes thinking of the class "furniture" as a possible higher order class. Instead, with quite a bit of suggestion by the interviewer, Miles forms a class of things associated with eating and a class of nearly identical cribs.

If Miles had given this solution from the start, and it had not been

so strongly suggested by the interviewer, it would be difficult to distinguish his reasoning from that of a concrete-operational child. However, when we look at the whole of Miles' performance, we see the difficulty he has moving freely back and forth between higher order classes and the classes they include. This leads to difficulty anticipating the end results of the classes he is forming, or in other words, coordinating what he has done with what he is trying to do. This is what distinguishes his performance from one that is guided by the reversible mental operations of the concrete-operational stage.

---

## THE CONCRETE-OPERATIONAL STAGE -- TRUE CLASSES (GENERALLY BETWEEN 8-12 YEARS OF AGE)

---

RE-READ PAGES 17 THROUGH 20 OF CHAPTER ONE.

The simplest way to describe the classification of the concrete-operational child is to say that with respect to the sorting of objects, his/her classification skills are similar to those of adults. They can form true classes, reason about inclusion relations, as well as other types of class structures, move back and forth within class hierarchies, anticipate the result of beginning classifications, and so on.

In all these respects, the concrete-operational child is able to reason more systematically about classes than are pre-conceptual and intuitive children. On the other hand, what distinguishes the concrete-operational child from the adult is that these reasonings are expressed more systematically when referring to concrete objects, (things that can be handled, looked at, etc.), than when referring to words.

This is the basis for the term "concrete operations." For example, Ryan knows that there are more wooden than red beads. As his argument, he says that you can take the paint off the beads "and they'll be just plain wooden." This is a perfectly acceptable way of saying that all the red beads are only some of the wooden beads. Yet, in an interview not shown in the film, Ryan claims that all eagles are birds. When asked if there are more birds or eagles in the world, he says there are more birds. This is correct, but when asked to explain, he says that this is so because there aren't many eagles in Oakland. In fact, the issue has nothing to do with the number of eagles, but with the fact that eagles are only some of the birds. With objects, Ryan can reason this out. With abstract verbal references to classes he has difficulty.

The difficulty that the concrete-operational child has with verbal, as opposed to concrete, reasoning may seem a simple distinction between a child at this stage and an adult. This is deceptive, however, for the distinction lies in the much more complex issue of how thought is organized. The development of classification skills is certainly not completed during the concrete-operational stage. The organization of class logic continues to develop, enabling an adult to answer a question such as, "Are there more things in the world that are not birds or that do not fly?" This is logically more complex than the type of question that a concrete-operational child can answer. It involves two types of reversibility. However, since these further issues of classification are outside the scope of Early Childhood Education, we will leave their pursuit to your own curiosity.

## SOME CONCLUDING REMARKS ON STAGES OF CLASSIFICATION

Throughout this unit we have focused on three stages of classification found in children between four and eight years of age. We've already indicated that some form of classification is going on in children who are younger and that the organization of classification skills continues to develop through late adolescence.

One additional and important point should be made. Each of the stages covers a relatively long period of time: pre-conceptual stage from two to five years of age; intuitive stage, five to seven years of age; concrete-operational stage, eight to twelve years of age. By now you should be familiar with some of the things that are common to the classification skills of children within each stage. However, you should also keep in mind that there is progress made by children within stages as well. The two year old pre-conceptual child, for example, is less sophisticated in his/her classification than is the five year old pre-conceptual child. The same holds for children within all stages. In a sense, development is a series of numerous changes, organized around major changes in thinking. The three stages covered in this unit, characterize the major changes. Within each stage there are subtle, but observable, changes as well.

## LOOKING FOR STAGES OF CLASSIFICATION

### Activity 10: Reviewing the Videotape

In this activity you will review the videotape on classification. The purpose of this activity is to explore in more detail the distinction between the class reasoning of the pre-conceptual, intuitive, and concrete-operational stages.

INSTRUCTIONS FOR ACTIVITY 10

1. View the videotape with the following 10 questions in mind. You may want to stop the tape, re-wind, etc., to examine behaviors you're not sure of.
2. Use Activity Form F.
3. Discuss your observations with others so that everyone's insights can be shared.
4. You can use the transcript of the videotape to take notes (Appendix B).

ACTIVITY FORM F: Questions for Reviewing Classification Tape

Name: _____

Date: _____

To be used for Activity 10 (page 92).

1. What are some things that Ian and Darrilyn do that give the impression that they can produce "true classes?"

2. What evidence is there that Ian and Darrilyn are in the pre-conceptual stage of classification?

3. What are some of the things that Miles does that give the impression that he is in the pre-conceptual stage?

4. What are some of the things that Miles does that give the impression that he is in the concrete-operational stage?

5. What is some of the evidence for placing Miles in the intuitive stage?

6. What is one important mistake that the interviewer makes when asking Miles to sort the objects onto the three pieces of paper?

7. How is the mistake corrected?

8. What are some things that Ryan does that give the impression that he is in the pre-conceptual stage?

9. What are some things that Ryan does that give the impression that he is in the intuitive stage?

10. What evidence is there that Ryan is in the concrete-operational stage?

FOLLOW-UP TO ACTIVITY 10:

Here are the questions with possible answers:

1. What are some things that Ian and Darrilyn do that give the impression that they can produce "true classes?"

   Ian and Darrilyn both put together things that are alike.

2. What evidence is there that Ian and Darrilyn are in the pre-conceptual stage of classification?

   Both are concerned with appearance and spatial arrangements in their classes.

   In all cases, the intension and extension of the classes are not coordinated.

   Both believe that there are more red than wooden beads.

3. What are some of the things that Miles does that give the impression that he is in the pre-conceptual stage?

   Miles creates graphic collections (e.g., table scene and the symmetrical arrangement of babies).

   He creates classes that lack intension (e.g., putting cribs and glasses together).

4. What are some of the things that Miles does that give the impression that he is in the concrete-operational stage?

   Miles forms classes of things that are similar to each other and coordinates intension and extension.

   Miles combines the table, chairs, silverware, glasses into a higher order class, "things that relate to eating."

5. What is some of the evidence for placing Miles in the intuitive stage?

   Miles has difficulty being able to coordinate the classes he has formed with the task of combining objects to make fewer classes.

   The only classes Miles forms without a good amount of suggestion and prodding by the interviewer are ones in which the contents are maximally similar, e.g., spoons together, knives together, etc.

6. What is one important mistake that the interviewer makes when asking Miles to sort the objects onto the three pieces of paper?

   When Miles is originally asked to sort the objects onto three pieces of paper, it is not made clear that <u>all</u> the objects should be sorted.

7. How is the mistake corrected?

   It is still possible to explore Miles' ability to combine groups by adding another piece of paper and removing the chairs from one of the first three pieces of paper.

8. What are some things that Ryan does that give the impression that he is in the pre-conceptual stage?

   Ryan uses the letters to create words. At one point, while combining blue shapes, he includes a red square.

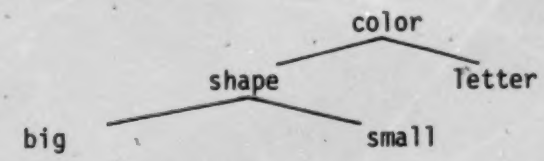
9. What are some things that Ryan does that give the impression that he is in the intuitive stage?

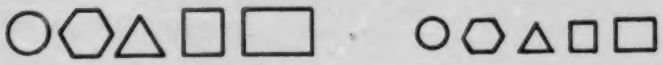
   In sorting the letters, Ryan does not coordinate intension and extension, e.g., some letters are put together because they are the same color, but not all the letters of that color are placed in that group.

10. What evidence is there that Ryan is in the concrete-operational stage?

    Ryan is able to consider the letters as belonging to the classes "red," "blue" and "yellow" and combine them with piles of similar color shapes.

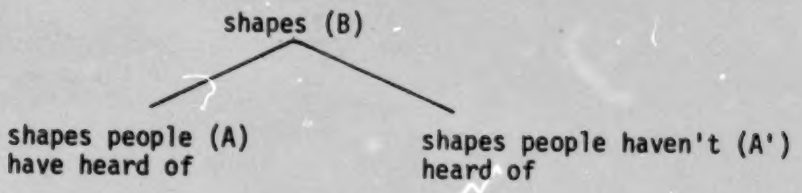
    He breaks these color piles into classes of letters and shapes, and the shapes are further divided into types of shapes, which themselves are arranged according to size.



He is able to correctly reason about the red and yellow bead problem.

He can reason about a class and its complement and a class to which both belong (A + A' = B).




Though we didn't ask, we can assume that if we asked Ryan, "Are there more shapes or more shapes that people have heard of (A vs. B)?" Ryan would have said there are more shapes because shapes people have heard of are only some of the shapes.

## Activity 11: Sharing and Assessing Your Interviews

In this activity you will share with others what you did with children in Activities 8 and 9 (pages 57 & 63). The purpose is to look at what kinds of evidence you have for the child's stage of classification and to consider what additional information you could get to help you decide.

MATERIALS

You will need the objects you used in interviewing children in Activities 8 and 9 and the record you kept (Forms C, D, E) on children's performance.

INSTRUCTIONS FOR ACTIVITY 11

1. You and the other members of the group should arrange to share at least one of your interviews completed in Activity 8 (class inclusion) and Activity 9 (sorting).
2. When demonstrating to other members in the group, use the actual material you used with children and use Activity Forms C, D, and E to remind you of what you did and how the child responded.
3. Discuss among each other what the evidence is that leads you to believe that a given child is in one of the three stages discussed in this unit.
4. Discuss the similarity and differences between children of the same approximate age and those of different ages.
5. Discuss how the interviews went well and not so well.
6. Discuss what kind of information you now realize you failed to get, and how you might get this information next time you interview a child.

## Activity 12: Demonstrating Three Stages of Classification

In Activity 12 you will use the objects you started collecting at the beginning of this unit on classification to demonstrate how a child in each of the three stages might classify the objects.

MATERIALS

Use any materials you have collected (e.g., miniature toys, leaves, rocks, shells, buttons, etc.).

INSTRUCTIONS FOR ACTIVITY 12

1. Work with a partner.
2. Arrange your collection of objects to form examples of:
   a. graphic collections (pre-conceptual)
   b. non-graphic collections (intuitive)
   c. concrete-operational classes.
3. Discuss with your partner how children of each stage would reason about the classes and how they would respond to instructions to combine groups into larger groups or break larger groups into smaller groups.

FOLLOW-UP TO ACTIVITY 12:

By this point you have gained a good understanding of some of the problems and tasks used to explore the child's understanding of classification. Furthermore, you have learned to recognize behaviors that reveal the character of the child's understanding. In the following section we briefly summarize the main things to look for in classification tasks. For any of the forms listed on the following pages you should be able to answer all of the accompanying questions if you've done the interviews correctly and if you've kept records of the appropriate behaviors.

We've presented the forms and their related questions in a way that should be useful for keeping records on individual children. The same sort of questions can be applied to any classification task you may wish to use. In the last section of Chapter 3 "On-going Assessment," we'll discuss the use and importance of records in assessing a child's development.

CHILD RECORD: CLASS INCLUSION

Your name _____ Child's name _____

Date _____ Child's age _____

Name of child's teacher _____

To be used as a record of child's performance on a class inclusion task.

Does the child understand the nature of the materials?

- That all the materials are made of the same thing; in this case wood? Yes ____ No ____
- That some of the materials are red and some yellow? Yes ____ No ____

Does the child understand simple class relations?

- That if all the yellows are taken away, the reds will remain? Yes ____ No ____
- That if all the reds are taken away, the yellows will remain? Yes ____ No ____
- That there are more red beads than yellow? Yes ____ No ____
- That if the wooden ones are taken away, nothing will remain? Yes ____ No ____

Does the child understand class inclusion relations?

- That there are more wooden beads than red beads? Yes ___ No ____
- That the red beads are only some of the wooden beads? Yes ___ No ____
- That a necklace made out of all the wooden beads would include the red beads? Yes ____ No ____
- That a necklace made of wooden beads would be longer than one made of red beads? Yes ____ No ____

What stage do you think the child is in? Which other stage is the child close to?

Pre-conceptual _____ _____

Intuitive _____ _____

Concrete-operational _____ _____

COMMENTS: _____

_____

_____

_____

CHILD RECORD: FREE SORTING

Your name _____ Child's name _____

Date _____ Child's age _____

Name of child's teacher _____

To be used as a record of a child's performance on a free sorting task.

Does the child form graphic collections?

- Is the child concerned with arranging the objects, e.g., lining them up, creating patterns, creating representational images? Yes ___ No ___

Does the child form collections of objects that are all the same in some way?

- Do some of the groupings contain elements that all have a common property? Yes ____ No ____
- Are graphic collections formed within any of the class groups, for example, letters made into words? Yes____ No____
- Does the child indicate (words) how all the members of the group are the same? Yes ____ No ____

Does the child classify all the objects? Yes ____ No ____

Does the child coordinate intension and extension?

- If a group of things with a common property is formed, are all the objects with that property included in that group? Yes ____ No ____
- Is this true for all the classes formed? Yes ____ No ____
- Is there a parallel organization of classes instead of an inconsistent one in which, for example, all squares are put together, but rectangles are put into piles of big and small; or all shapes are

classified according to their shape properties, but letters are classified by color? Yes ____ No ____

- If the organization is not parallel, describe in what ways it is inconsistent. _____

_____

_____

Does the child construct mostly small classes that are maximally intensive?

- Do the child's groups contain just a few elements that are very similar, e.g., all the small red triangles are together, all the big blue squares, etc.? Yes ____ No ____

Does the child construct mostly large classes that are maximally extensive?

- Do the child's classes contain many elements that are minimally similar to each other, e.g., a group of "shapes with sides?" Yes ____ No ____

Does the child construct a class with only one thing in it? Yes ____ No ____

What stage do you think the child is in? Which other stage is the child close to?

Pre-conceptual _____ _____

Intuitive _____ _____

Concrete-operational _____ _____

COMMENTS: _____

_____

_____

_____

## CHILD RECORD: STRUCTURED SORTING

Your name _____ Child's name _____

Date _____ Child's age _____

Name of child's teacher _____

To be used as a record of a child's performance on a structured sorting task.

Can the child combine groups to form higher order classes?

- Does the child combine, for example, yellow, red, and blue squares to form a class of squares? Yes ____ No ____
- Is the organization of the classes parallel? Yes ____ No ____

Can the child reclassify the material in new ways?

- How many different ways can the child find to classify the same materials? _____
- Does the child reclassify all the materials? Yes ____ No ____
- Is the organization parallel each time? Yes ____ No ____

Can the child break classes into subclasses? Yes ____ No ____

- Are the classes broken down in the same way, e.g., if the shapes are subdivided by color, so are the letters? Yes ____ No ____
- If the classes are subdivided inconsistently, describe in what ways they are inconsistent, e.g., the shapes are divided by color, but the letters are divided by shape, curved or straight. _____

_____

_____

_____

_____

| What stage do you think the child is in? | Which other stage is the child close to? |
|---|---|
| Pre-conceptual _____ | _____ |
| Intuitive _____ | _____ |
| Concrete-operational _____ | _____ |

COMMENTS: _____

_____

_____

_____

## ON-GOING ASSESSMENT

In Chapter 5 we talk about the broad educational implications for what you have learned about classification and for Piaget's theory in general. However, before concluding this chapter, we should discuss the importance of establishing an on-going program for assessing all the children in the classroom for their developing understanding of class relations. By getting to know all your children and by assessing the same child a number of times during the year, you can expect to see a number of things.

- You will come to see a broad common pattern to the thinking of all your children.
- You will find that while there are similarities, children also differ from each other. For example, children will differ on how well they understand your instructions, and this will not always be a result of their level of development. How comfortable the child is with you, how familiar the child is with the expressions you use, etc., are all factors that affect the child's performance.

  Children will also differ in their level of development. Even if all the children are in the same stage, some will be just entering the stage and some ready to enter the next stage.
- You will find that children who are doing "equally well" in school are not necessarily at the same stage in their development. For example, two pre-school children may know their numbers, colors, alphabet, etc., equally well, but perform at somewhat different levels on classification tasks.

- Likewise, you will find, for example, that children may be at the same stage, even though one is doing well in school and the other not so well.
- Maybe most importantly, you will find that children whom you regarded as less advanced actually show themselves to be developmentally as far along as their classmates. On the other hand, you might come to realize that the problems a child is having with certain subject matters are the result of the child's level of development and not necessarily an inability on your part to do a "good job" teaching.

Keeping Records

To get to know your children in the above terms is important. To better see and understand the similarities and differences among your children can only make you a better teacher. The first step for such insight comes from keeping records of your interviews with the children. This will allow you to compare children, to check your impressions against records of actual performance, to see how a child progresses through the year, to get a better feel for the relationships between the child's performance (or your expectations) and the child's stage of development, and to compile relevant information to share with parents.

A record for any child should consist of a description of the task you used, the materials, the questions you asked, and the child's responses. Such a record is called a "protocol." The various activity forms used while interviewing children are examples of protocol forms. However, you do not need to follow these, and as you become a better interviewer, you will not want to restrict yourself to predetermined approaches. One way

to keep a protocol record is simply to make notes of what you are doing and saying (as you do and say them) and record what the child does and says. Your protocol record might look like the following:

Class inclusion: 10 wooden beads, 2 yellow, 8 red and a string to string them on.

Fred Ames — November 10, 1975

Age: 5 years, 3 months

| Examiner | Child |
|---|---|
| All the beads wood. | Correct |
| How many wooden beads? | Correct |
| How many red? | Correct |
| More red than wooden beads? | Mistake |
| What's left if I take all the wooden beads away? | Unsure |
| Which is longer - a necklace of wooden beads or one of red beads? | Mistake |

After you have interviewed the child and while your memory is still fresh, you should use your protocol to fill out a summary record of important child behaviors. Record forms such as those on pages 101-106 provide examples. With both the protocol and summary, you have a good record of the child's performance and a basis for making judgments about the child's stage of development and understanding of class relations.

# CHAPTER 4

## ADDITIONAL WAYS TO EXPLORE CLASSIFICATION WITH CHILDREN

Class relations are involved in everything that requires reasoning about similarities and differences. Since the formation of all concepts involves the use of either class relations, order relations or both,[17] the degree of understanding that a child has of classification affects much of his/her other thoughts and activities. You have already explored children's understanding of classification through a number of different tasks. As you develop more familiarity with its expression in a variety of other physical classification problems, you will become increasingly aware of its place in children's activities in general, including those that make up the subject matter of the classroom.

It is important to extend your exploration of class relations and their development to a broader range of tasks than those discussed in the preceding chapters. By experimenting with a variety of activities, you will see the variations that make classification easier or more difficult to reason about. For example, a child may be able to arrange a number of very similar items into classes, but may not be able to find all the shapes that are different from a chosen shape in exactly one way while being the same in all other ways. Experiences with a variety of classification activities will also give you a better feel for the similarity between tasks that allow

---

17. Alward, Keith R., Working with Children's Concepts, a unit of the FLS.

you to explore the natural course of development and tasks that are a part of your teaching activity. Lastly, the more varied the tasks, the better you will get at working with children, learning how they understand your requests and questions, the kinds of inconsistencies the child recognizes in his/her own behavior and judgments (and those not recognized as well), and how the child deals with problems that are recognized but difficult to solve. In short, the better you understand classification and its use in different types of activities, the better you will understand the child's understanding of his/her world and how that understanding is communicated.

All the new tasks are presented in summary form. Specific administration and recording procedures are omitted. Therefore, before using the new tasks, review the procedural notes on interviewing techniques covered in Chapter 2 (pages 49 thru 52). If there are any questions about how to proceed, or what to expect, consult the primary reference given for each task. One important issue to consider is that variations in the kinds of material used and the manner in which the task is presented can change the nature of the problem for the child. At the very least, they make the problem more or less difficult. Remember this when you get unexpected results.

Most of these activities are physical problems or ones requiring the production of pictures. Activities of this character make it easier for children to express their understanding and easier for you to interpret a child's behavior. More importantly, physical activities involving concrete objects provide the context in which children can do their best work and with the use of objects and pictures, you see most clearly what they do or do not understand. Furthermore, when judging objects according to their similarities and differences, children are also forming concepts about their world.

## CLASSIFICATION BY TOUCH [18]

Classification tasks can be varied by presenting the materials behind a screen. When Piaget used this kind of a problem, he placed the objects inside a framework representing a little house with walls and roof made of cloth. The child was asked to put his hands "under the walls," to feel the objects. Then the standard questions were asked.

When screening a task it is important to remember to use objects that are easily discriminable by touch (color, of course, is out). If you make them too hard to discriminate, the problem becomes very difficult, but not for lack of the ability to classify. Geometric shapes are good.[19] For example, spheres, ellipses, squares, rectangles, and triangles can be used. The problem can then be broadened by adding two standard sizes and/or two versus three dimensional objects. To make the problem as easy as possible, use some objects with holes and/or some with serrated edges.

## VARIATIONS ON CLASS INCLUSION: "ALL AND SOME" [20]

In Chapter 2 the standard class inclusion problem was presented. It involved a set of objects that have one property in common and one unique property, thereby forming a simple additive classification. For example, ten wooden beads might be used: seven blue beads and three yellow beads.

---

18. The Early Growth of Logic in the Child, Chapter 7.

19. See the Property Blocks described in Using Toys and Games with Children, a unit of the FLS.

20. The Early Growth of Logic, Chapter 3.

The assessment culminates with asking if there are "more wooden beads or more red beads."

To study the child's understanding of the class-inclusion relationship further, Piaget developed a new task for use with children from four to eight years of age. For this task, eight to 20 objects made up of red squares, blue circles, and a few blue squares are arranged as in the following pattern:

The child is then asked questions like: "Are all the circles blue?" "Are all the squares red?" "Are all the blue ones circles?" "Are all the red ones squares?" As would be predicted from the class-inclusion results, young children have difficulty with these questions. This can be clearly seen when they are asked to justify their answers.

In order to trace the development of the child's understanding of "all" and "some" further, a number of different tasks can be used. The simplest is merely to ask for "all the blue ones," or "all the blue squares" or "some of the red ones."

A problem directed at understanding how well the child is able to discriminate class relationships is to ask him/her to reproduce a collection like the one pictured above. Piaget asked children to choose the objects they would need from boxes of objects sorted by color and shape. It is important to ask the child about his/her choices as s/he makes them, that is, prior to the point where the child may merely match objects one by one.

To make this problem more difficult, the child may be given a good look at the model and then asked to reproduce it from memory, with the model screened. Again, it is informative to ask the child about particular choices. When doing problems that require memory, use only a few objects so as to focus on the child's ability to understand relationships rather than his/her memory span.

## SUPPLEMENTAL GAMES AND MATERIALS

One of the easiest forms of pre-classification is involved in the standard form board.[21] Here the child is asked to fit a set of objects with different shapes into a board with a corresponding set of cutouts. The object is to place the correct object into the corresponding cutout. The task is made a little more difficult by using some objects and cutouts with similar shapes but different sizes. This is not a complete classification problem because differences are only grossly discriminated, while similarities are only matched.

There are a number of other games that are oriented toward helping children use these classification skills. Here are a few, using a flannel board with 36 small colored shapes made of wool or flannel -- circles, squares, and triangles. There are two sizes of each shape, and there are three colors of each size red, yellow, and blue.[22]

21. Using Toys and Games with Children, pp. 66 & 74.

22. See Flanrel Board Game I, II, III in Using Toys and Games with Children, pp. 42-44.

1. Pick up one yellow triangle and remove all other yellow triangles. Then ask the child to find an object that goes witn the one you've chosen. This is good training, because a similarity must be found (shape or color) while overlooking another similarity (color or shape). Hence, more than matching is required.
2. Another variation is to ask the child to find a shape that doesn't belong with the others, as with this simple arrangement:

3. A more important discrimination is to choose an object that doesn't belong in the following set. Here, a difference must be attended to while overlooking a similarity.

4. If the young child finds the above games easy, try a more difficult one with the same objects. For example, the child is challenged to find all the shapes that are different from a chosen shape in exactly one way (and the same in all others). A yellow square might be picked, in which case a yellow square of a different size is an appropriate choice. A red square of the same size would also be appropriate. The child is always asked to explain his/her choices. Another variation is to ask the child to find objects that are the same in exactly two ways, etc.

All of the above games are good for assessing how well the child can identify similarities and differences. After this has been done, the same objects can be used to do a standard assessment of the ability to classify, that is, to simultaneously coordinate similarities and differences between objects.

## MULTIPLICATIVE CLASSIFICATION [23]

Multiplicative classification involves the ordering of objects into two or more additive classes, simultaneously. The simplest kind of problem is to order two different kinds of objects, for example: red and blue. A correct solution would result in four piles: red circles, red squares, blue circles, blue squares.

When giving simple multiple classification problems to young children, it is helpful to use a box that is divided into four sections by two removable partitions. Then the child can be helped to understand the problem by asking him to put things together (1) so that they have something in common, and (2) so that when one or the other partition is removed, the objects on each side of the remaining partition will still have something in common.

It is also helpful to use objects that can be grouped in a number of ways. If this is done, you can show the child how to do it one way and then ask him/her to do it another. A well developed ability to perform multiple classification is marked by the ease with which classification

23. Piaget, Jean, The Early Growth of Logic in the Child, Chapter 6.

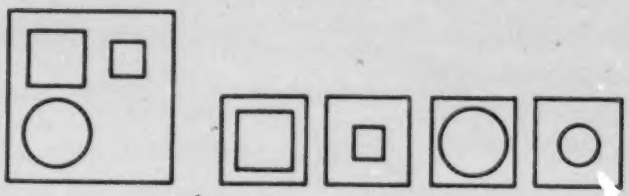
criteria can be switched. The ability to perform multiple classification develops at the same time as additive classification.

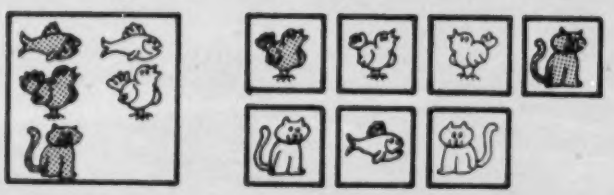
A multiple classification problem can be made more difficult by using more classifications and distracting characteristics. In the problem below,[24] the child must simultaneously categorize the cards into four subclasses based on who is eating, and also into four subclasses based upon what is being eaten. In so doing, s/he must overlook distracting characteristics like the presence of absence of eyes in the dog house, rings on the fence, etc.

24. See Pattern Games, Using Toys and Games with Children.

## VARIATIONS ON MULTIPLICATIVE CLASSIFICATION

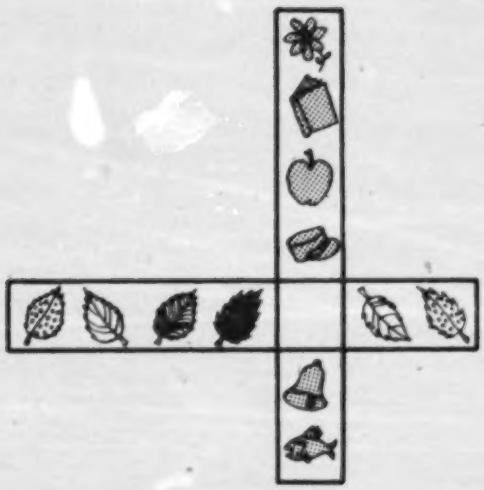
There are numerous variations on multiplicative classification that come under the general category of Matrix Tes . A series of these kinds of problems can easily be made into a game by s rting with very simple problems. All of the varieties require the child to complete an already partially formed matrix.





The child is asked to complete the matrix on the left, choosing from the objects on the right. The first task is very simple. The second offers some additional problems because the orientation of the plain cat's tail must also be considered.

To make these kinds of problems even more difficult, more information can be left out as in the following example.



Problems like this one are called intersection problems. The ability to do them well develops as much as two years later than the standard multiplicative classification problem.

The above tasks, though sketchily presented, give some idea of the range of activities that require classification skills. Similar tasks make up a fair portion of curricular materials and items on I.Q. or achievement tests. By learning about how classification skills develop and the range and situation in which they are required, you will be better able to select activities that are appropriate to the children you work with and better

able to evaluate the appropriateness of tests that are presently used to assess your children's progress.

# CHAPTER 5

## EDUCATIONAL IMPLICATIONS

Piaget's first five books, published in the 1920's, were enthusiastically received and widely discussed. In this book you have been introduced to some of the ideas that are discussed in those works: children's thinking progresses through stages; at each stage there is a common quality to much of their thought; and, prior to middle childhood, children's concepts are organized differently than those of adults.[25] However, the initial popularity of these findings had little impact on American psychology or education, and between the 1930's and 1960's few people were familiar with his work.

This surprising indifference was the result of a predominant involvement with Behaviorism, according to which knowledge is a copy of external facts and can be taught through example, practice, correction and reinforcement.[26] These views are older than Behaviorism itself, as evidenced by the traditional methods of education, such as rote learning, memory exercises and teacher-directed activities. Such practices reflect a belief that knowledge is memory of past events and that good teaching corrects or reinforces student responses to tasks and questions. Most educational practice in America today has its roots in history and its theoretical rationale in Behaviorism. This, however, is rapidly changing--in large measure because of Piaget's work.

---

25. These same principles are explored in other areas of knowledge by the three remaining parts of the ECT series and by the FLS unit titled Working with Children's Concepts.

26. Langer, Jonas, Theories of Development.

Toward the end of the 1950's a number of factors prompted a renewed interest in Piaget's studies. For one, his general findings seemed valid, yet unexplainable in behavioristic terms, thus providing a new focus for theoretical psychology. For another, the topic of mental development itself was virtually untouched by behavioral research. The breadth and richness of Piaget's preceding four decades of study opened an exciting and unexplored area of obvious importance. Lastly, Piaget brought to psychology a method of study and focus that was beginning to surface in a variety of disciplines. Piaget calls this approach "structuralism" and describes it as a study of how the parts of a system work together to form the system itself.[27] What you have learned about the development of classification is an example. In classification the parts of the system are the mental activities of combining and separating objects and events according to their properties. These activities are organized to form a pattern or system. As you've learned, this system changes in systematic ways from one stage to the next.

Whereas behaviorists regard knowledge as a recording of external experience, Piaget has attempted to show that all knowledge has an underlying organization. This organization cannot be taught or recorded from examples. It is the result of the individual's constant regulation of physical and mental activities becoming increasingly systematic and better organized. The fact that an eight year old reasons about classes in adult-like fashion and the four year old does not is not the result of more experience with adult classifications. By categorizing objects and events according to

---

27. Piaget, Jean, Structuralism.

properties that are personally interesting and important, children come to organize their activities in more systematic terms. As they do, the classifying activity inevitably takes the form we regard as logical and adult-like.

Piaget has created a powerful picture of intellectual development but, for the most part, has left its educational implications to be explored by others. We now know rich and fascinating facts about what children do and do not believe. These facts have obvious educational implications, for education carries as its primary responsibility an understanding of what children regard as true. Piaget also provides a technique for exploring the common patterns of thought in general. As educators come to use his ideas for exploring thinking, they will be better at anticipating what children can and cannot do and more confident in stimulating and following children's thoughts.

Lastly, Piaget's theoretical account of how children progress in their mental development contradicts many commonly held assumptions about thinking. In its broadest terms, it suggests that thought is not derived from language, though language serves an important function; that thought is not abstracted from the environment, but actively constructed in a self-determined interaction with the environment; that the inability of children to understand certain truths is not due to a lack of relevant information, but to an inability to coordinate information in the required fashing. These important additions to our understanding of thought suggest educational practices that are quite different from traditional approaches. The theory suggests trusting children in more active and self-directed learning, asking their own questions, and finding means of answering them. It suggests that interactions between children are as important as those between adults and children, and that freely exploring the physical and social environ-

ment is as, or more, important than sitting quietly and doing one's lessons. It suggests that children be stimulated to reason rather than memorize, and that they be encouraged to reflect upon their own views and their implications. However, because this psychological theory is relatively new to a majority of educators, it will take time to fully fashion it into educational practice.

## THE DEVELOPMENT OF CLASSIFICATION AND ITS EDUCATIONAL IMPLICATIONS

When first introduced to the important relationship between classification and thought, it is hard not to feel a responsibility for teaching it. The fact that young children classify so differently than adults, and the presence of countless educational products designed to teach classification, makes this seem all the more reasonable. In some respects there is justification for guiding children to specific classification activities, and in other respects it is a misuse of energy and possibly even harmful to the child's overall education.

It now seems clear that all healthy and active children come to classify in increasingly systematic ways and that by middle childhood these classification skills are logical from the adult perspective. It is also fairly well recognized that it is very difficult to teach children an understanding of classification that is more advanced than one they naturally hold. Success in doing so is achieved only when children are at a transition point between one stage and the next, or, in other words, when they are close to understanding on their own what is being taught. Furthermore, once success is achieved, it by no means guarantees an overall improvement in the quality of a child's thinking.

On what basis, then, is it reasonable to engage children in classification activities? Classification activity is a good way for children to explore properties of objects and events, to learn to focus on properties that others consider important, and to think about the implications of combining and separating objects according to their properties. As long as the focus is on helping children explore their own understandings, rather than replacing it with advanced thought, classification can be fun and rewarding for teachers and children. Moreover, by providing classification activities for children, the teacher can get a clearer sense of their level of development and their understanding of the elements they are classifying. However, if teachers attempt to enforce classifications that are more sophisticated than a child's level of development, there is risk that the child will divorce the activity from his/her own ability to reason, and replace it with attempts to imitate and to memorize what is being taught. To separate mental activity from reason replaces self-reliance with a dependency upon the teachings of others. More importantly, it may lead the child to conclude that his/her way of thinking and viewing the world is wrong when in fact it is the only way that s/he can reason.

It seems reasonable to state that, if anything, the implications of Piaget's theory are to avoid teaching classification. Why replace vital aspects of education with activities designed to advance reasoning in the direction it is destined to take of its own accord? Rather, the effort should be directed toward providing children with opportunities to exercise whatever understanding of classification they may have and to appreciate the results of their efforts. Children will become increasingly aware, but at their own pace; and soon enough, earlier ways of thinking will be replaced by more advanced reasoning.

Many American educators have come to the conclusion that if thinking progresses through stages, then it is unreasonable to expect things from children that they are not yet ready to understand or do. The notion of "readiness" is a popular theme in American education. "Don't try to teach what the child is not ready to learn." Piaget's theory suggests that all knowledge has organization and that the organization advances through a sequence of orderly stages. Thus, the problem is not to avoid certain kinds of knowledge, but rather to examine all aspects of subject matter (curriculum) in terms of the level of understanding being demanded of the child. This is an enormously difficult task because it requires understanding the underlying organization of thought during all of the relevant stages, and understanding how these issues bear on all the subject matter of the classroom.

This series of four units is an attempt to address part of this problem. By introducing you to the character of thought in its various forms of organization during the early childhood years, you will be better able to anticipate the kinds of problems your children will find difficult or easy to solve. But ultimately, the answer to the question "What is the child capable of doing or capable of learning?" is determined by the child. By coming to know how to explore a child's thinking,and by respecting the integrity of the child's understanding,you will also become more convinced that the child's own interests,likes and dislikes, best determine what s/he is ready to understand. Things that are too easy or too difficult do not interest the child nearly as much as the investigation of new problems and ideas suggested to the child by his/her own exploration. The natural course of intelligence is to find new problems suggested by the solution of old ones. These problems, and the knowledge necessary to find their solutions,

are what the child is ready to learn.

What you have learned about children's classification between four and eight years of age provides a basis for anticipating what children can be expected to understand. For example, the definition of a word describes properties shared by all the things to which the word refers. Because of their inability to systematically coordinate similarities and differences, preconceptual children do not understand definitions in the way that older children do, nor are they particularly interested in definitions.

Piaget has endeavored to show that concepts of space, time, number, measurement, chance, cause and effect, geometry, proportions, and so on, all depend upon an understanding of the logic of class relations. As a result, pre-operational children cannot form systematic understandings of these concepts. The remaining three units in the ECT series explore some of these areas. The unit titled Working with Children's Concepts explores the general relationship between classification and concepts.

## OPEN-RESPONSIVE EDUCATION

Piaget's work has had an obvious and significant influence on the teaching of specific subjects. It is not in the least unusual to find developers of curriculum materials in areas as diverse as music, drama, art, social relations, math, science, and social studies, referring to Piaget as the foundation for their suggested practices. Yet a more significant impact is felt in the contemporary trends of open education. Educators are increasingly recognizing the need to turn more of the learning process over to the child, to get children out of their seats, inventing problems and solutions, talking freely with adults and each other, and, on the whole,

actively participating in decisions about what to study and how to study it.

A number of different educational approaches travel under the broad label of "open education" and there are disagreements among proponents of individual programs. But what is common to all is a concern with the character of the child's activities; and there are a number of ways in which Piaget's theory bears on this general question.

1. Central to the open-education philosophy is a belief that children learn best when they have a responsibility for the learning process. Because knowledge is constructed and made up by the learner, learners must develop skills in self-direction and they must be given opportunities to approach problems in ways that suit their individual character and disposition. Students should be involved in selecting projects and ideas to focus on; selecting resources to work with; determining when and for how long activities are pursued; participating in the evaluation of their learning; and in selecting the nature of feedback they receive.
2. Children's interests play an important role in the open-education environment. First, it is recognized that interest is an indication of whether a child is developmentally ready for a subject -- as presented. Secondly, it is understood that interest is a powerful source of energy for learning. Learning does not take place without an active involvement,and this occurs more readily when there are genuine and personal interests.
3. In open-education classrooms the learning process is an active one in the sense that children can use a variety of resources and a variety of learning modes. Rather than learning arithmetic, for example, through rote-practice activities, workbook activities,

and listening to the teacher, children may be involved in working with physical objects that represent arithmetic concepts, playing games that involve mathematical concepts, making a movie, story, or play about a mathematical concept, keeping a diary of arithmetic used at home, and so on. Furthermore, the nature of the child's activities should be guided to exploring relationships rather than isolated facts. For example, rather than separately learning that 7+5=12 and 2+10=12, the child might be led to see the relationship between these two formulas; that, for example, if you take 5 from the first and add it to the second number in the first formula you get the second formula; (7-5)+(5+5)=2+10=12. What do you think? Would this principle apply to all formulas in which two numbers add up to a third?

4. All education concerns itself with developing an appreciation and skill in reasoning. Piaget's theory has provided a useful insight in this regard. He has shown that underlying all reasoning is a pattern of organization that can be identified as intelligence. As the child applies his/her interests and active consideration to events and objects, the pattern or organization undergoes changes and evolves toward a more satisfying and encompassing form. This course of emerging reason holds for any area of knowledge to which the mind may be applied. It is something that is neither learned nor acquire at birth. For reason to take its hold, the mind must be applied and challenged so that preliminary ideas are found to be false and wanting. The formulation of beliefs and the seeking of means to test beliefs is the exercise of intelligence. Asking children to imitate the patterns of reason imposed by others can-

not serve this function. This principle is appreciated in open-education and provides the basis for many of the practices that fall under that heading.

5. Open-education proponents stress the importance of social interactions among peers. Throughout his career Piaget has insisted that mutual cooperation and interaction among children sharing common goals and interests is essential to the development of reason. This means that children should be allowed to explore concepts through mutual play, through discussion, through sharing points of view, and through attempts to work together on common goals. The mutual interests of children are an important foundation for social and intellectual development and they should be built upon in the classroom.
6. Lastly, teachers in open-education classrooms must develop skills and talents that are different from those required of the traditional teacher. Open-education is not something that can be programmed or packaged in the sense of strict lesson plans or a guided series of instructions, such as workbooks. Open-education requires a flexible approach in which individual needs can be met as they arise, where spontaneous questions can provide the focus for an extended project, where new challenges can be proposed as opportunities arise.

Eudcation, as a question of learning and as a question of society, is enormously complex. It is something in which everyone has a share and a say, and it is something that affects and is affected by every factor in the human complex. The school itself is as much affected by education as it in turn affects the individual. Every intellectual revolution has left

its imprint on the goals and values of the school. How these new goals are achieved is a matter of technology: the development of intelligence through doing. The issue of open-education, as with most other important educational issues, is strictly a question of what individuals in society want and value. The technology of producing confident students in open-education environments is a documented fact. The success of the British Infant School, the Bankstreet and Responsive Follow Through Programs, testifies to the ability of open-education teachers to achieve the goals and values of society.[28] The question is whether society wants to adapt the goals of open-education.

Piaget expresses his own view, which is often quoted by proponents of open-education:

> The principal goal of education is to create men who are capable of doing things, not simply of repeating what other generations have done -- men who are creative, inventive, who discover.
>
> The second goal of education is to form minds which can be critical, can verify, and not accept everything they are offered....we need pupils who are active, who learn to find out by themselves, partly by their spontaneous activity and partly through material we set up for them; who learn early to tell what is verifiable and what is simply the first idea to come to them.[29]

Piaget is a scientist of immense stature. He is truly as much a source of intellectual revolution as were Freud, Galileo, and Aristotle. But science cannot, and should not, determine values. It can, however, educate

---

28. Rayder, Nicholas F., et al., Effects of the Responsive Education Program: New Data.

29. Ripple and Rockcastle (Eds.), Piaget Rediscovered.

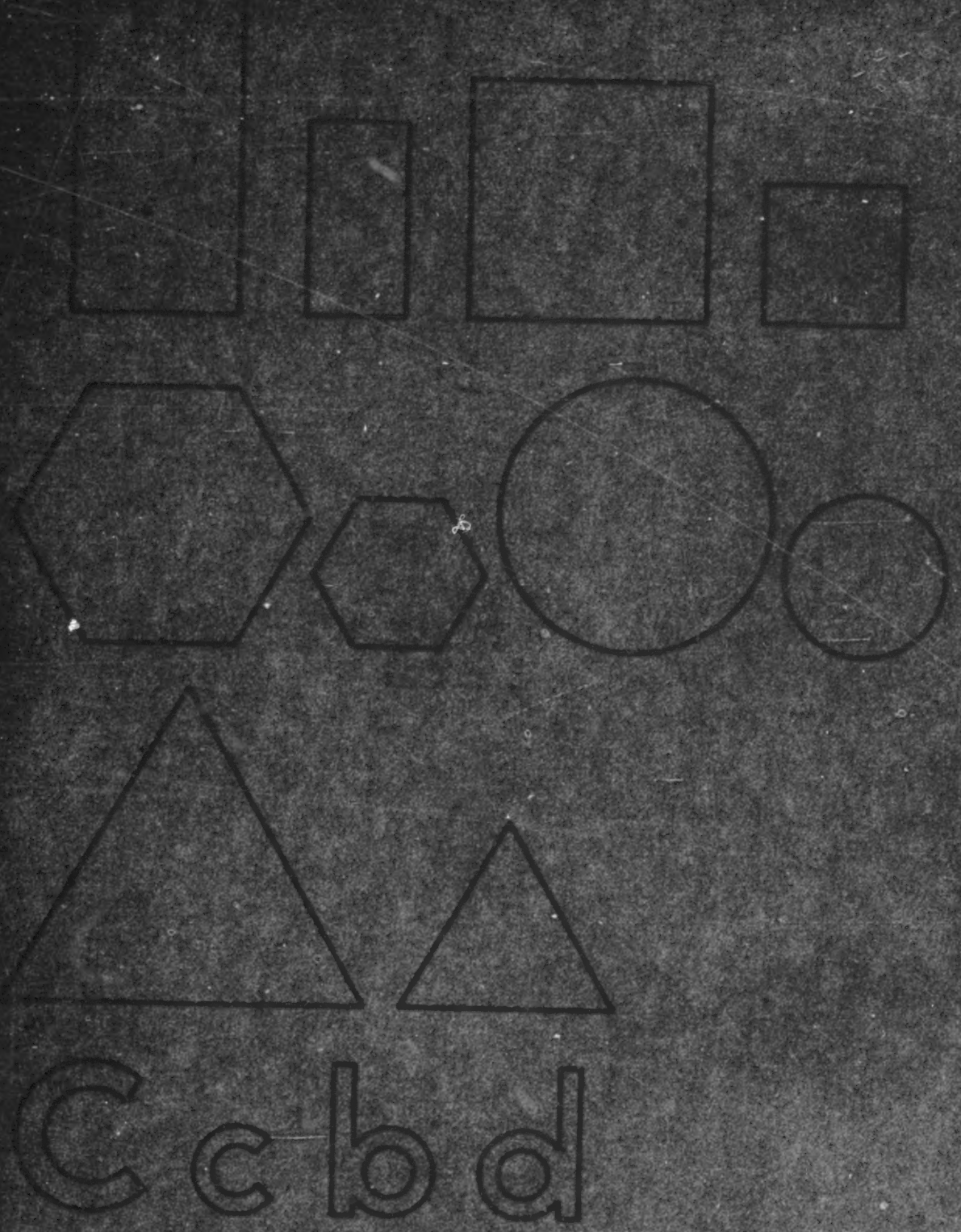
our values and provide means of realizing the goals we set for ourselves. Through Piaget's work, extended by countless others who are concerned with the nature of intelligence , we can see that all children who are active come to develop increasingly refined intelligence. This would and does happen irrespective of schools. It is the inevitable result of mental activity. But the question of school is critical and goes beyond the development of intelligence or reason in the abstract. School is properly concerned with the nature of subjects to which the intelligence is applied.

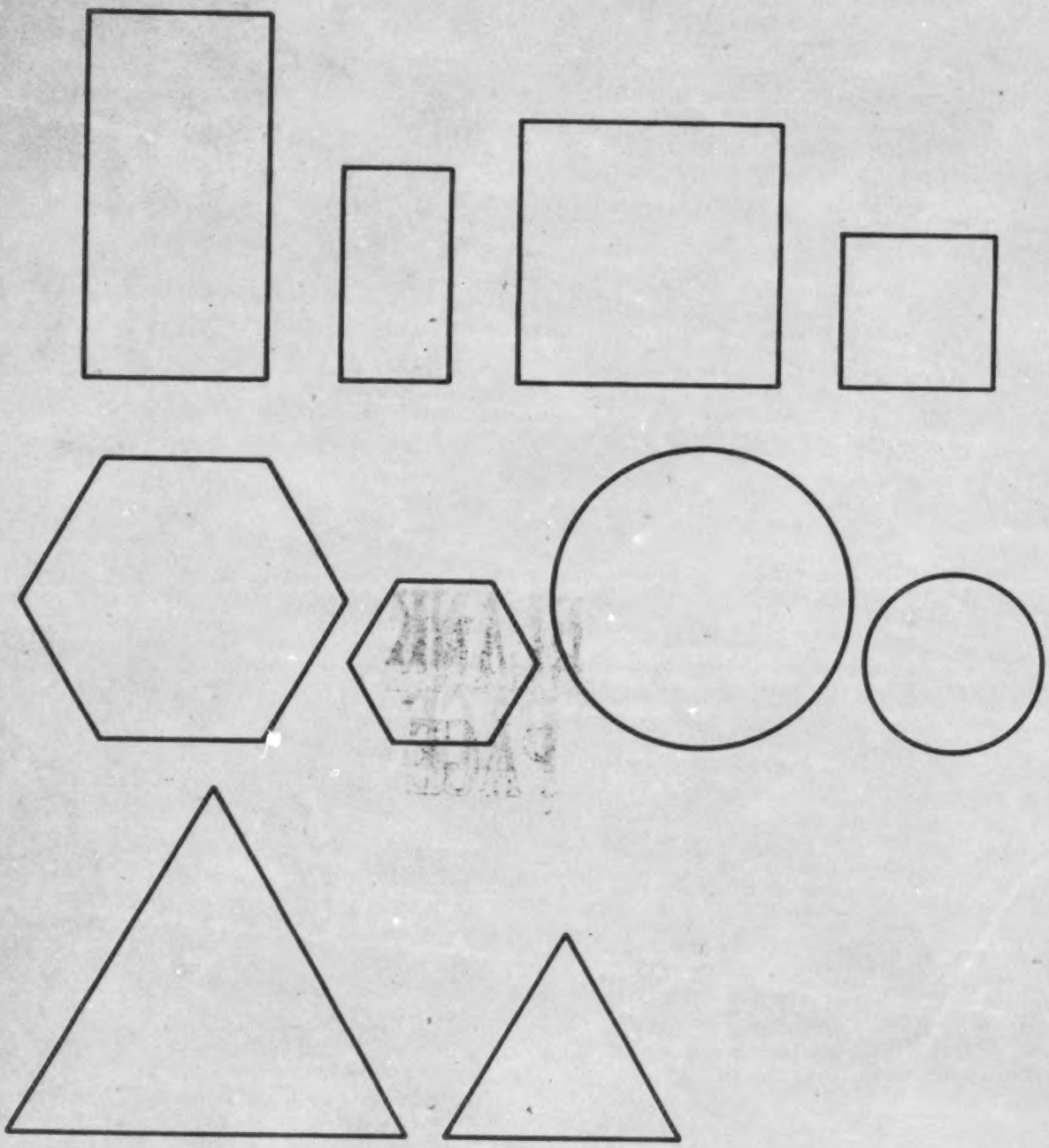
What Piaget suggests and practitioners have shown is that classrooms and schools can be created in which students function with freedom in a climate of honesty and respect, and still achieve what is expected by the society into which they must be absorbed. What is surprising to many seems obvious to others: intelligence directed and followed by interest leads to learning what society expects.

It is a myth to think that children are innately opposed and foreign to reading, writing, and arithmetic. These are simply society's ways of representing forms that intelligence naturally takes. Children develop in their linguistic intelligence, and reading and writing are simply shared ways of expressing this intelligence. Likewise, children develop in their understanding of class and order relations. Arithmetic is no more than socially shared ways of expressing this intelligence. These shared systems are conventions and not intelligence itself. Conventions must be learned from others. But it is the nature of people, and especially children, not to learn from others if in so doing one is demeaned, embarrassed, ridiculed, or demoralized. Only by personal interests free from fear and supported by others can children be expected to share and extend the exciting forms of personal and collective intelligence. Open-education at its best sets a stage.

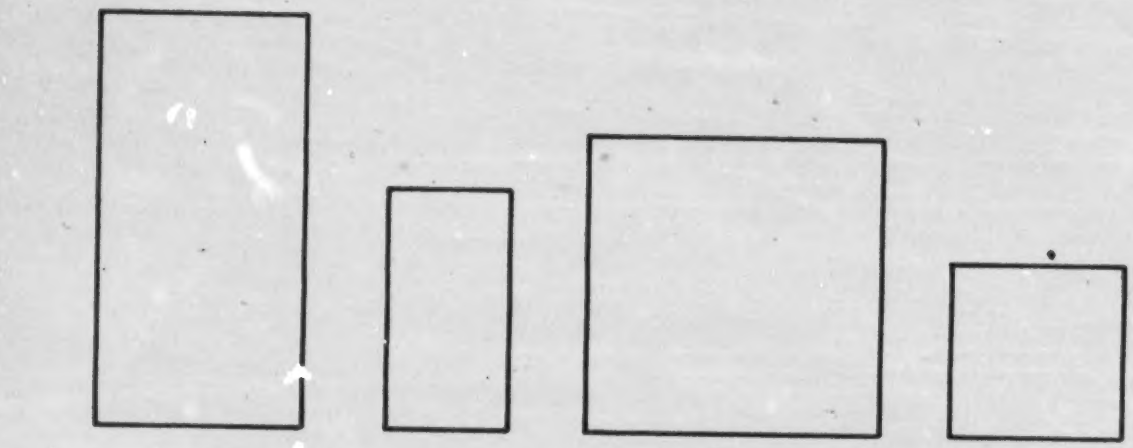
# APPENDIX A

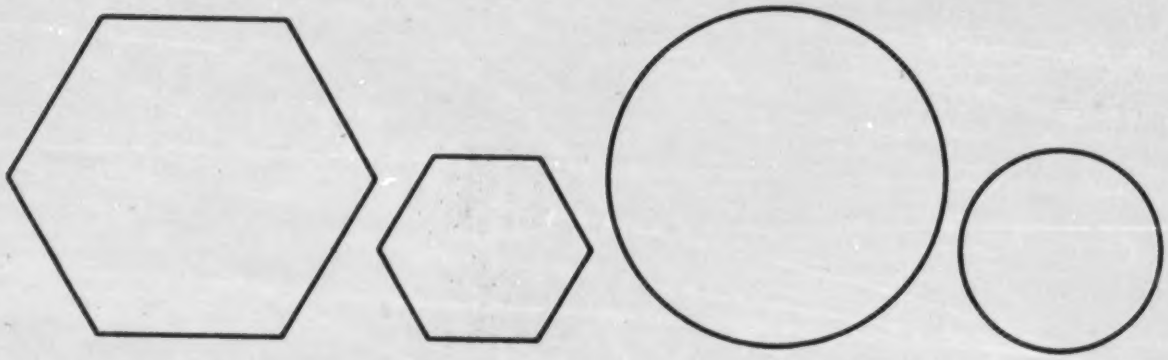
## CLASSIFICATION MATERIALS

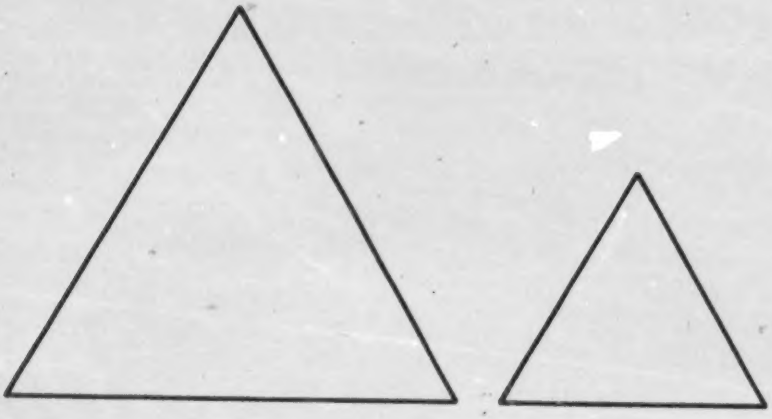

c c b d



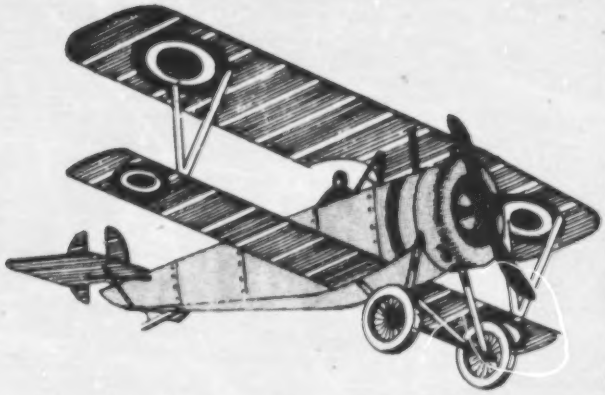
P B G R

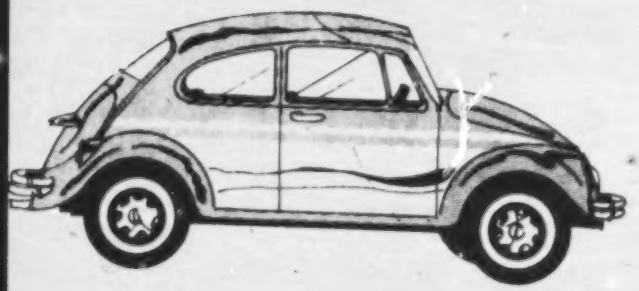


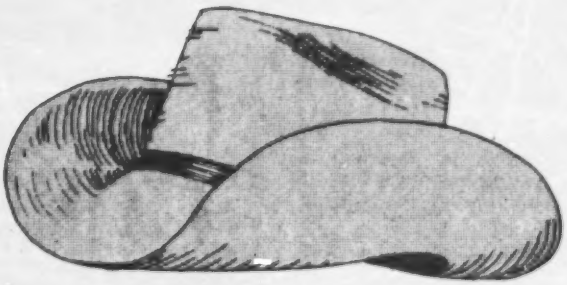




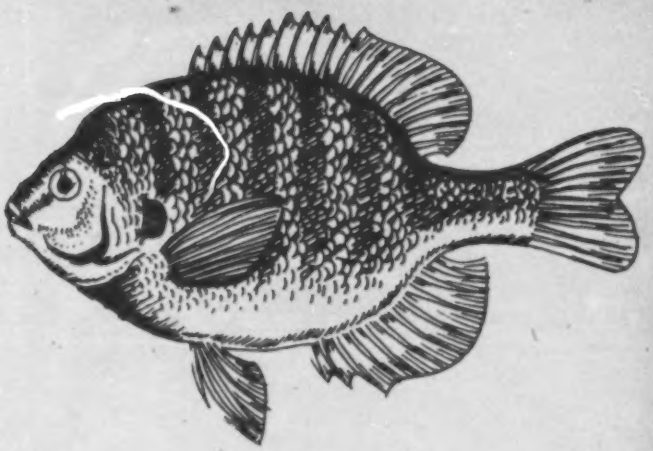
T I O Q

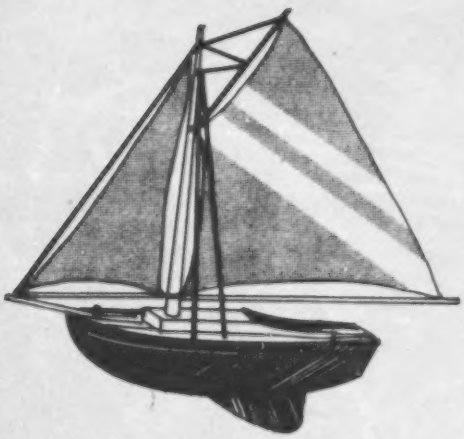


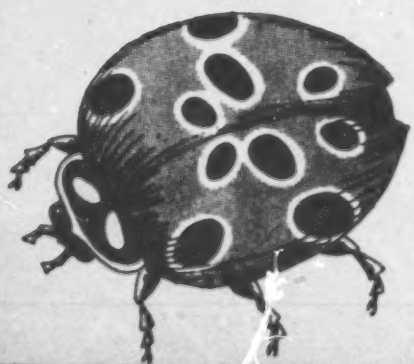


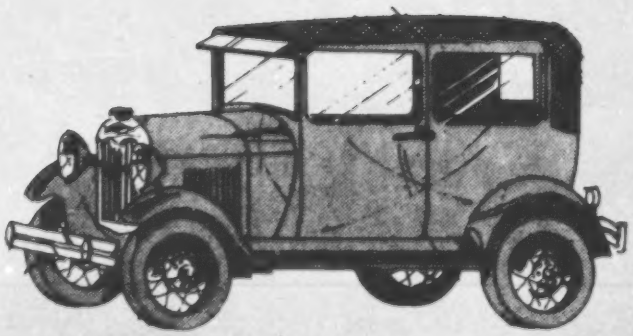


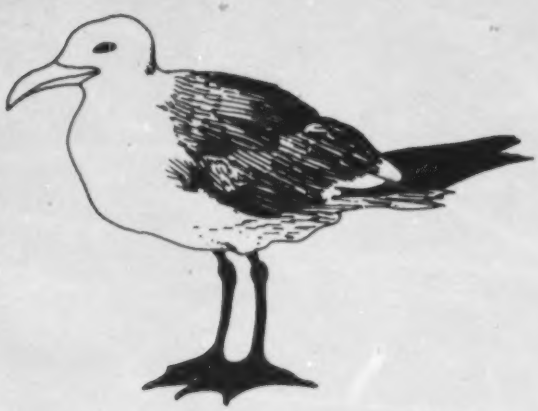
12
11
10
9
8
7
6
5
4
3
2

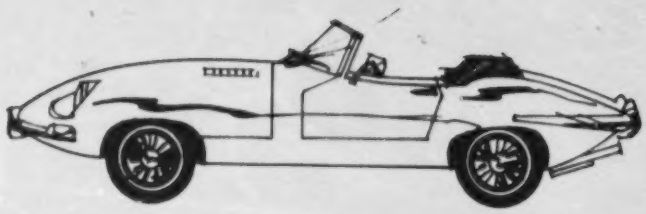


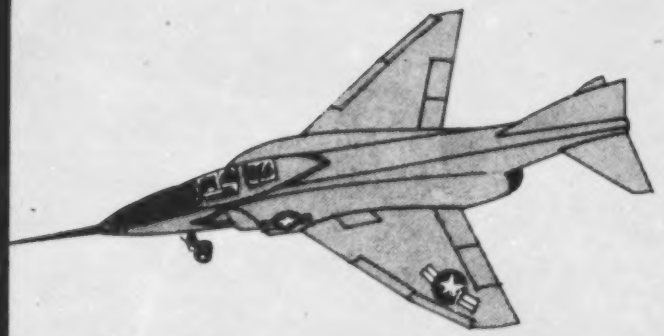


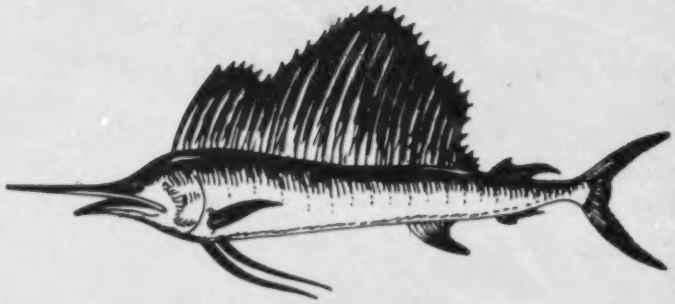


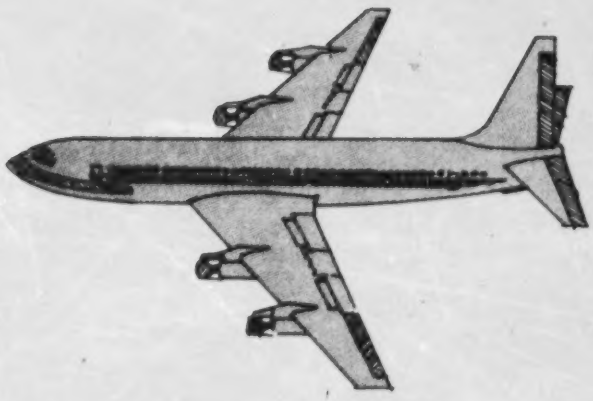


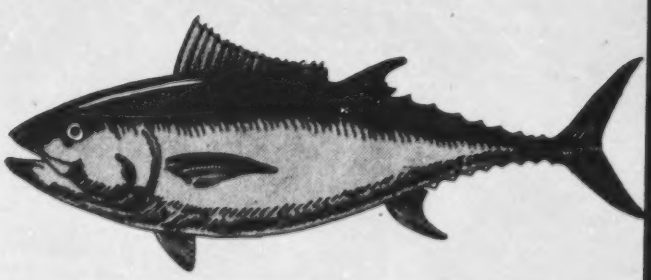












# APPENDIX B

## TRANSCRIPT OF VIDEOTAPE

THE GROWING MIND: A PIAGETIAN VIEW OF YOUNG CHILDREN--

THE DEVELOPMENT OF CLASSIFICATION

Those who work with young children recognize the difficulty they have understanding adult concepts. Their reasoning is often different from ours. In this film series we will draw upon the work of Jean Piaget to show the internal organization of child thought and its gradual progression towards adult forms. The apparent inaccuracies of child thought are part of a pattern through which all children pass.

This film explores three stages in the development of children's classifications and reasoning about classes. Classification is critical to all thought. Each stage of classification has its own character and organization and each new stage is an advance over earlier ones.

Four year old Ian realizes that if all the wooden beads are taken away, none will be left. Yet he tells us that there are more red than wooden beads. This illustrates a type of reasoning belonging to the pre-conceptual stage. This is a stage of mental development through which all children pass. It's a particular type of thought with its own form and organization.

Ryan, an eight year old, reasons differently from Ian.

Ryan knows that there are more wooden than red beads. He shows that he can consider all the beads as red and yellow,and at the same time consider all of them as wooden. This reversibility of thought characterizes the concrete-operational stage to which Ryan belongs.

Four year old Darrilyn provides more insight into the nature of the young child's thought. She calls all the beads "bean-beads."

For most four year olds, a class such as wooden beads is a spatial collection. When asked to consider the red beads, the group of wooden beads is mentally separated so that only the red and yellow beads exist. These groups are what both four year olds compared.

Ian is asked to put together shapes that are alike.

The careful placing of objects in lines and the fitting together of triangles shows that for Ian, classes are tied to their appearances or spatial arrangements. Because of these characteristics, classes formed by children in the pre-conceptual stage are called "graphic-collections."

Ian builds a tower of shapes, adding each shape because it matches some object in the group rather than sharing a common property with all the objects in the group.

Darrilyn too is asked to put together things that are alike.

Darrilyn's collections are also graphic. This is revealed in a number of ways.

The squares are carefully aligned with each other.

The adding of small squares creates a nice spatial symmetry.

Trianges are added to the arrangement of squares because they add to the spatial symmetry.

The square does not visually fit the circles.

Darrilyn ends with a number of graphic collections. While the collections are of different shapes, they are similar in appearance and each pile fits together as a spatial whole.

For the pre-conceptual child, the very act of grouping objects is often enough to define a class.

Later in the interview, Darrilyn continues to form graphic collections.

Other shapes are added to the squares as if Darrilyn is trying to create a visually interesting whole rather than a class.

Now Darrilyn combines shapes according to their color.

The graphic nature of the classification is shown by her careful arrangement of blue and red squares around the color piles. A concern with appearance and arrangement, rather than similarities and differences, has dominated Darrilyn's classifications. This is a clear indication that her notion of class is grahic and belongs to the pre-conceptual stage of thought.

The stage following pre-conceptual thought is called the intuitive stage. The child becomes increasingly concerned with classifying according to the similarities and differences among objects.

The man with the rifle is kept separate from the men with buckets.

The growing concern with similarities and differences leads to a beginning struggle with higher-order classes. These classes are composed of sub-groups that are different from each other, but also similar at a higher level of abstraction. For example, tables and chairs can be combined in the class of furniture.

While six year old Miles can form classes of similar objects, the symmetrical arrangement of the babies shows that appearance and arrangement still play a role.

When asked to combine groups, Miles creates a graphic collection : the arrangement of a table scene.

Miles shows that he can break this graphic collection into the original classes defined by the similarities and differences between objects.

This task requires Miles to combine some of his groups to form higher-order classes. He instead places already formed classes on the three pieces of paper and leaves a remainder of objects to be sorted.

Miles is unwilling to put the table with the chairs because of the differences in appearance even though both are furniture.

Rather than anticipating how the remaining objects could be grouped into two piles, such as furniture and utensils, Miles starts by placing things that are alike on the two pieces of paper.

Ryan's earlier thinking about the wooden bead problem showed that he is at the concrete-operational stage of thought. We therefore expect Ryan to show more advanced classifications than we have yet seen.

Ryan quickly classifies the shapes according to similarities and differences.

The letters,however, offer an obstacle to his classification.

He eventually forms a variety of small classes including letters of the same color, groups of similar letters, and graphic collections in the form of words.

When asked to combine his groups, Ryan instead re-classifies all the objects on the basis of color.

Arrangement is not important in Ryan's classification of blue objects.

Ryan ends by dividing the color groups into smaller classes of letters and shapes.

Ryan struggles with forming three classes on the basis of similarities and differences. Having classed all the letters together, he is faced with the difficulty of constructing two classes out of the remaining material.

Ryan's unique solution reveals the flexibility of concrete-operational thought.

Darrilyn and Ian are typical of most four and five year olds. They are in the preconceptual stage.

Their classes are called graphic collections because appearance and spatial arrangement of objects is the basis of their classifications.

When asked to put together things that are alike, the pre-conceptual child may group objects that go well together, look good together, or form a nice pattern.

As a result, a graphic collection may contain a variety of dissimilar objects,or contain objects that are similar to those in other classes.

The nature of graphic collections leads quite naturally to reasoning about classes in a way that is markedly different from adult thinking.

Ian and Darrilyn both argue that there are more red than wooden beads because the spatial nature of their class concepts leads them to compare only the red and yellow beads.

The intuitive stage to which most six and seven year olds belong is illustrated by Miles.

Children in this stage can classify objects according to their similarities and differences. However, this is just beginning and children in this stage have difficulty combining groups to form higher-order classes. Difficulty also arises when the child must anticipate how a set of objects could be divided into a given number of classes.

Around eight years of age, most children enter the concrete-operational stage. During this stage, classification takes on an increasingly systematic character. Ryan is just entering this period. He knows there are necessarily more wooden than red beads because all of the red beads are only some of the wooden beads.

He can combine groups to form higher-order classes,and at the same time break these classes into sub-classes.

This ability to reason about the relationships between classes makes it possible for Ryan to invent unique yet systematic solutions to classification problems.

The development of thought goes through a series of stages, each with its own form of reasoning. Piaget has shown that this developmental progression is not unique to individual children. It is universal and marks a progression whose natural course is towards increasingly systematic and internally consistent thought.

The child encounters the world at his own level of development. Before passing to the next stage, the child must first experience the world through his own eyes. Reasoning that appears illogical to the adult may be perfectly natural to the child. It is his way of seeing and will only progress if it is used. It is necessary for the child's development that he be allowed to explore his own view.

In this film on classification, we have examined one area of development. Other films in the series cover additional topics, showing that for each, there is a natural and similar progression of stages leading towards more accurate and systematic ways of seeing the world.

# APPENDIX C

## REFERENCES AND ADDITIONAL RESOURCES

**Some of Piaget's Translated Works**

These earliest of Piaget's books concern the general character of children's thinking between three and eight years of age, as revealed in either natural observations or discussions with children. At the time of their writing, Piaget did not regard them as important works, and he later criticized them for their dependence on the child's verbal reasoning. However, these books set the stage for much of his later work and provided the foundation for public interest. Of his major descriptive works, these are probably the most readable.• The works are listed in order of their original French publication dates.

(1923) The Language and Thought of the Child. New York: Meridian, 1955.

• (1924) Judgment and Reasoning in the Child. New Jersey: Littlefield, Adams and Co., 1966.

(1926) The Child's Conception of the World. New Jersey: Littlefield, Adams and Co., 1965.

(1927) The Child's Conception of Physical Causality. New Jersey: Littlefield, Adams and Co., 1965.

(1932) The Moral Judgment of the Child. New York: Collier, 1962.

These three books express Piaget's major observations on the mental development of infants. The Origins of Intelligence provides a theoretical model of sensory-motor intelligence. The Construction of Reality describes the first understandings of space, time, objects, and causality. The original French title, Origins of the Symbol, suggests the underlying focus of Play, Dreams, and Imitation in Childhood. Each of these three books will probably disappoint the casually interested reader. The Construction of Reality is the easiest of the three to read.

(1936) The Origins of Intelligence in Children. New York: Norton, 1963.

(1937) The Construction of Reality in the Child. New York: Basic Books, Inc., 1954.

(1946) Play, Dreams, and Imitation in Childhood. New York: Norton, 1962.

---

• These works provide information on the development of classification in children and/or classification activities.

The following books make up the largest single focus in the study of cognitive development. In them, Piaget explores the development of logical and sub-logical thought between four and 12 years of age and its expression in a broad cross-section of knowledge. Each is composed of a rich array of concrete-manipulative experiments and the corresponding responses of children. The Growth of Logical Thinking is Piaget's major work on formal-operational thought. The beginning Piaget student will find the descriptions rich and readable, though tedious. The theoretical accounts are highly abstract and complex.

(1941) The Child's Conception of Number. New York: Norton, 1965.

(1946) The Child's Conception of Movement and Speed. New York: Ballantine, 1971.

(1946) The Child's Conception of Time. New York: Basic Books, Inc., 1969.

(1948) Piaget, Inhelder, and Szeminska, The Child's Conception of Geometry. London: Routledge and Kegan, 1960.

(1948) Piaget and Inhelder, The Child's Conception of Space. New York: Norton, 1967.

(1951) -----, The Origin of the Idea of Chance in Children. New York: Norton, 1975.

(1955) Inhelder and Piaget, The Growth of Logical Thinking from Childhood to Adolescence. New York: Basic Books, Inc., 1958.

• (1959) -----, The Early Growth of Logic in the Child. New York: W. W. Norton and Co., Inc., 1964.

The following books provide an overview of Piaget's theory and his general views on the nature of knowledge. The Psychology of the Child provides his best introductory overview of development between infancy and late adolescence. As suggested by their titles, two of the books present Piaget's thoughts on education. They do not provide simple educational prescriptions.

(1939 & 1965) Science of Education and the Psychology of the Child. New York: Viking, 1971.

• (1947) The Psychology of Intelligence. New Jersey: Littlefield, Adams and Company, 1963.

(1948) To Understand is to Invent: The Future of Education. New York: Grossman, 1973.

(1964) Six Psychological Studies. New York: Vintage Books, 1967.

- (1966) Piaget and Inhelder, The Psychology of the Child. New York: Basic Books, Inc., 1969.

(1968) Structuralism. New York: Harper and Row, 1971.

(1973) The Child and Reality: Problems of Genetic Psychology. New York: Grossman, 1973.


**Piaget as Seen by Others**

These five books provide an overview of Piaget's theory and his main findings. Pulaski's and [illegible]ips' works are probably the most readable by lay persons. The book by [illegible]burg and Opper is an excellent overview of the main stages of develop[illegible]t from infancy to late adolescence. The books by Boyle and Flavell focus more on the formal aspects of Piaget's theory and are probably more useful to the advanced student. Flavell's book is a classic American interpretation of Piaget's general theory.


- Boyle, D. G., A Student's Guide to Piaget. London/New York: Pergamon Press, 1969.

- Flavell, John H., The Developmental Psychology of Jean Piaget. Princeton, New Jersey: Van Nostrand, with a foreward by J. Piaget, 1963.

- Ginsburg, Herbert, and Opper, Sylvia, Piaget's Theory of Intellectual Development: An Introduction. New Jersey: Prentice-Hall, 1969.

- Phillips, John L., Jr., The Origins of Intellect. San Francisco: W. H. Freeman, 1969.

- Pulaski, Mary Ann Spencer, Understanding Piaget: An Introduction to Children's Cognitive Development, New York: Harper and Row Inc., 1971.


The book by Issaacs is a good introductory presentation of quantitative concepts (number, measurement, time, etc.) between four and eight years of age. Brearly and Hitchfield provide a similar treatment of additional topics such as space, morality and science.


Brearley, Molly and Hitchfield, Elizabeth, A Guide to Reading Piaget. New York: Schocken Books, 1966.

Issaacs, Nathan, A Brief Introduction to Piaget. New York: Agathon Press, 1972.

Dasen's article explores the relationship between culture and knowledge. Furth provides a rich and insightful presentation of Piaget's general theory. He includes seven short papers by Piaget. Langer describes three predominate views on mental development: behaviorist, structuralist, and analytic. Ripple and Rockcastle edited the presentations of a large American conference on Piaget. They include four papers by Piaget, a number of theoretical papers on education, and a large number of papers concerning curriculum projects based on Piaget's theory. The papers by Piaget are informative and quite readable.


Dasen, Pierre R., Biology or Culture? Interethnic Psychology from a Piagetian Point of View, Canadian Psychologist, April 1973, 14 (2), 149-166.

Furth, Hans G., Piaget and Knowledge: Theoretical Foundations. New Jersey: Prentice-Hall, 1969.

Langer, Jonas, Theories of Development, San Francisco: Holt, Rinehart and Winston, Inc., 1969.

Ripple, Richard R. and Rockcastle, Verne N. (Eds.), Piaget Rediscovered: A Report of the Conference on Cognitive Studies and Curriculum Development. Ithaca: School of Education, Cornell University, 1964.


These works reflect some of the research studies directed toward refining and clarifying Piaget's theory and its implications.


- Almy, Millie, with Chittenden, E. and Miller, P., Young Children's Thinking: Studies of Some Aspects of Piaget's Theory. New York: Teachers College Press, Columbia University, with a foreward by J. Piaget, 1966.

- -----, and Associates, Logical Thinking in Second Grade. New York: Teachers College Press, Columbia University, 1970.

- Dasen, Pierre R., Cross-Cultural Piagetian Research: A Summary, Journal of Cross-Cultural Psychology, 7, 1972, 75-85.

Elkind, David and Flavell, John H. (Eds), Studies in Cognitive Development: Essays in Honor of Jean Piaget. New York: Oxford University Press, 1969.

Hyde, D. M. G., Piaget and Conceptual Development: With a Cross-Cultural Study of Number and Quantity. London: Holt, Rinehart, and Winston, 1970.

- Kofsky, Ellin, A Scalogram Study of Classificatory Development. Logical Thinking in Children: Research Based on Piaget's Theory. Irving Siegel and Frank Hooper (Eds.), New York: Holt, Rinehart, and Winston, Inc., 1968.

• Siegel, Irving, and Hooper, Frank (Eds.), Logical Thinking in Children: Research Based on Piaget's Theory. New York: Holt, Rinehart, and Winston, Inc., 1968.

**Piaget's Theory and Education**

The following books and papers present a range of views on the general implications of Piaget's theory for education. The book by Schweibel and Rath presents a number of readable and excellent articles by various Piagetian scholars.

Alward, Keith R., The Implications of Piaget's Theory for Day-Care Education. Child Care: A Comprehensive Guide. Stevanne Auerbach Fink (Ed.), New York: Behavioral Publications, 1973.

-----, A Piagetian View of Skills and Intellectual Development in the Responsive Model Classroom. Non-published paper, Far West Laboratory, 1973.

Duckworth, Eleanor, Piaget Takes a Teacher's Look, Learning, October 1973.

Furth, Hans G., Piaget for Teachers. New Jersey: Prentice-Hall, 1970.

-----, and Wach, H., Thinking Goes to School: Piaget's Theory in Practice. New York: Oxford University Press, 1974.

Kamii, Constance, and De Vries, Rheta, Piaget for Early Education. The Preschool in Action. R. K. Parker (Ed.), Boston: Allan and Bacon, 1974.

Kohlberg, Lawrence, Cognitive Stage and Preschool Education, Human Development, 9, 1966, 5-7.

-----, The Concepts of Developmental Psychology as the Central Guide to Education. Proceedings of the Conference on Psychology and the Process of Schooling in the Next Decade -- Alternative Conceptions. Maynard D. Reynolds (Ed.), Leadership Training Institute -- Special Education, 1970.

Schweibel, Milton, and Rath, Jane (Eds.), Piaget in the Classroom. New York: Basic Books, Inc., 1973.

Sharp, Evelyn, Thinking is Child's Play. New York: Dutton, 1969.

Silberman, Charles E. (Ed.), The Open Classroom Reader. New York: Random House, 1973.

Sime, Mary, A Child's Eye View: Piaget for Young Parents and Teachers. New York: Harper and Row, 1973.

These books reflect a number of efforts to prepare teachers to interview children in areas of cognitive development. Lavatelli's work is well known but criticized by Piaget for her suggestion that training children to perform on Piagetian tasks is an appropriate educational goal.

- Alward, Keith R., Exploring Children's Thinking: Part 1 -- The Development of Classification, A FLS Unit. San Francisco: Far West Laboratory, 1975.

-----, Exploring Children's Thinking: Part 2 -- The Development of Order Relations -- Seriation, A FLS Unit. San Francisco: Far West Laboratory, 1975.

-----, Working with Children's Concepts, A FLS Unit. San Francisco: Far West Laboratory, 1975.

-----, and Saxe, Geoffrey B., Exploring Children's Thinking: Part 3 -- The Development of Quantitative Relations -- Conservation, A FLS Unit. San Francisco: Far West Laboratory, 1975.

Fogelman, K. R., Piagetian Tests for the Primary School. National Foundation for Educational Research in England and Wales, 1970.

- Lavatelli, C., Piaget's Theory Applied to an Early Childhood Curriculum. Boston: American Science and Engineering, Inc., 1970.

- -----, Teacher's Guide to Accompany Early Childhood Curriculum: A Piaget Program. Boston: American Science and Engineering, Inc., 1970.

- Lowry, Lawrence, Learning About Learning. Berkeley: University of California, 1974.

The following present some materials, activities, and suggestions for working with children.

- Attribute Games and Problems, Elementary Science Study, Education Development Center, Inc., McGraw-Hill Book Co., Webster Division, 1967.

Cuisenaire Company of America, Inc. 12 Church Street, New Rochelle, NY 10805.

Ennever, L., and Harlen, W., With Objectives in Mind: Guide to Science 5-13. London: Macdonald Educational, 1973.

Golick, Margie, Deal Me In -- Use of Playing Cards in Teaching and Learning. New York: Jeffrey Norton Publishers, Inc., 1973.

Nimnicht, G., et al., Using Toys and Games with Children, A FLS Unit. San Francisco: Far West Laboratory, 1975.

Nuffield Mathematics Project. New York: John Wiley and Sons, Inc.

Richards, Roy, Early Experiences: Beginnings -- A Unit for Teachers. London: Macdonald Educational, 1972.

Weikart and the Responsive Program Staff present two different broad applications of Piaget to early childhood education. Both are models for the National Follow Through Program. The Responsive Model Program has been implemented in hundreds of classrooms throughout the U.S. The paper by Rayder, et al., presents some of the findings on the effects of the program.

Rayder, Nicholas F., et al., Effects of the Responsive Education Program: New Data. San Francisco: Far West Laboratory, 1975.

Responsive Educational Program Staff, A Description of the Responsive Education Program. San Francisco: Far West Laboratory, 1976.

Weikart, David P.; Rogers, Linda; and Adcock, Carolyn, The Cognitively Oriented Curriculum: A Framework for Preschool Teachers. Urbana: University of Illinois, 1971.

**Films and Videotapes**

CRM Educational Films, Cognitive Development. (20 minutes) Available from CRM Educational Films, 7838 San Fernando Road, Sun Valley, CA 91352.

Davidson Films, Piaget's Developmental Theory:

- Classification. (19 minutes)

Conservation. (29 minutes)

Formal Thought. (33 minutes)

- Growth of Intelligence in the Pre-school Years.

  Jean Piaget: Memory and Intelligence. (44 minutes)

  Available through the University of California Extension Media Center, Berkeley, CA 94720.

Far West Laboratory, The Growing Mind: A Piagetian View of Young Children:

- The Development of Classification. (30 minutes)

  The Development of Order Relations -- Seriation. (27 minutes)

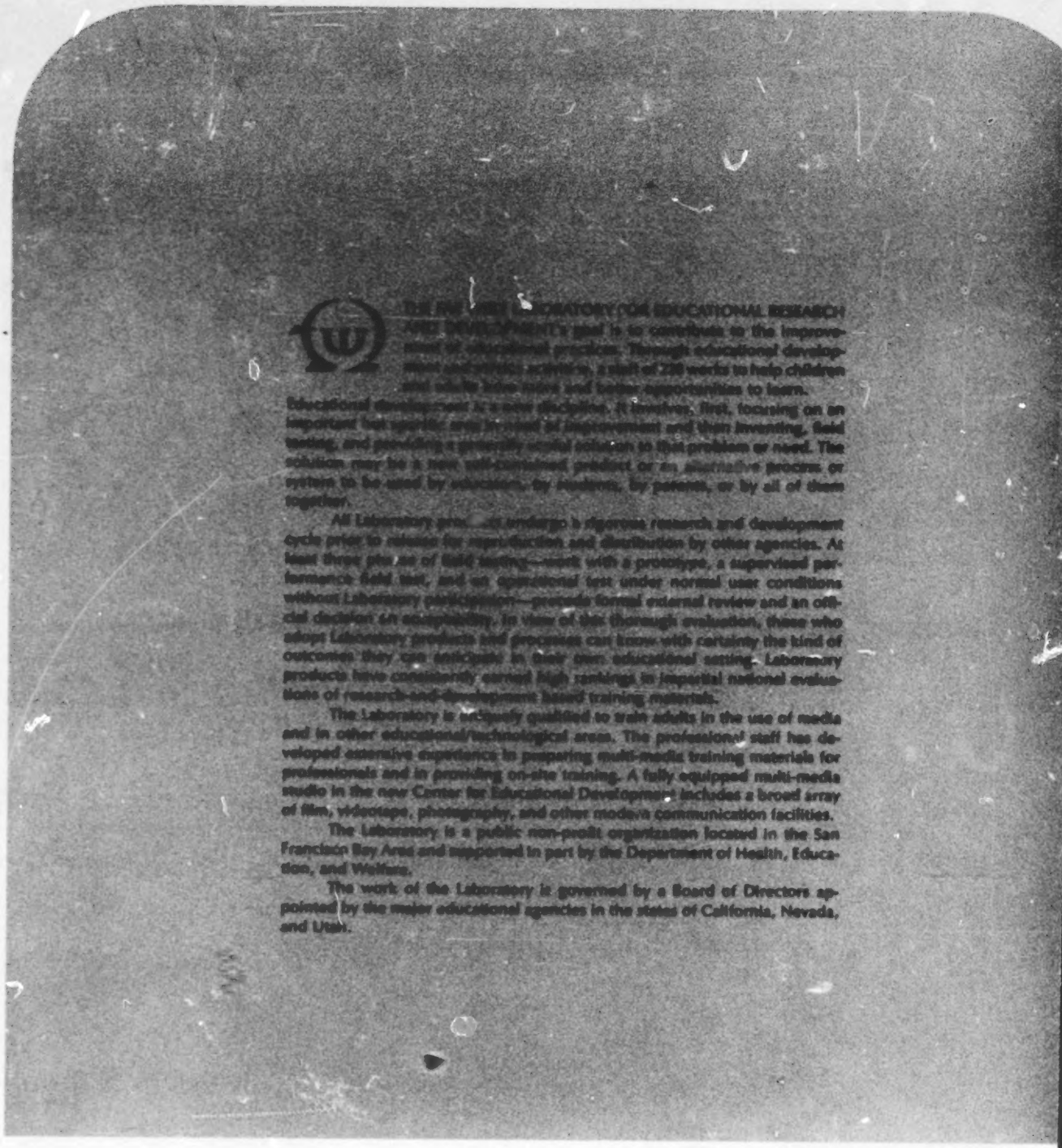
  The Development of Quantitative Relations -- Conservation. (32 minutes)

  The Development of Spatial Relations. (29 minutes)

  Available through the Far West Laboratory, 1855 Folsom Street, San Francisco, CA 94103.

- Phoenix Films, Learning About Thinking and Vice Versa. (32 minutes) Available through Phoenix Films, 743 Alexander Road, Princeton, NJ 08504.

The Jean Piaget Society, Equilibration. (35 minutes) Available through The Jean Piaget Society, Box 493, Temple University, Philadelphia, PA 19122.



THE FAR WEST LABORATORY FOR EDUCATIONAL RESEARCH AND DEVELOPMENT's goal is to contribute to the improvement of educational practices. Through educational development and training activities, a staff of 230 works to help children and adults have more and better opportunities to learn.

Educational development is a new discipline. It involves, first, focusing on an important but specific area in need of improvement and then inventing, field testing, and providing a generally usable solution to that problem or need. The solution may be a new self-contained product or an alternative process or system to be used by educators, by students, by patients, or by all of them together.

All Laboratory products undergo a rigorous research and development cycle prior to release for reproduction and distribution by other agencies. At least three phases of field testing—each with a prototype, a supervised performance field test, and an operational test under normal user conditions without Laboratory participation—precede formal external review and an official decision on acceptability. In view of this thorough evaluation, those who adopt Laboratory products and processes can know with certainty the kind of outcomes they can anticipate in their own educational setting. Laboratory products have consistently earned high rankings in impartial national evaluations of research-and-development based training materials.

The Laboratory is uniquely qualified to train adults in the use of media and in other educational/technological areas. The professional staff has developed extensive experience in preparing multi-media training materials for professionals and in providing on-site training. A fully equipped multi-media studio in the new Center for Educational Development includes a broad array of film, videotape, photography, and other modern communication facilities.

The Laboratory is a public non-profit organization located in the San Francisco Bay Area and supported in part by the Department of Health, Education, and Welfare.

The work of the Laboratory is governed by a Board of Directors appointed by the major educational agencies in the states of California, Nevada, and Utah.



A product of the

FAR WEST LABORATORY

FOR EDUCATIONAL RESEARCH AND DEVELOPMENT
1855 FOLSOM STREET SAN FRANCISCO, CA 94103

476FWL/C500 5/86(1)4)